TRANSMITTER DRIVE UNIT

MA.1720

CONTENTS

CONTENTS (Contd.)

CONTENTS (Contd.)

ILLUSTRATIONS

ILLUSTRATIONS (Contd.)

TECHNICAL SPECIFICATION

Porometers

Frequency: 1 to 29.9999MHz in 100Hz steps.

Frequency Stability ond Accuracy:

Standard version (Racal Fost warm-up type 9400):

(a) Frequency variation with temperature.
$\pm 1 : 10^{8}/^{\circ}C$ over temperature range $-10^{\circ}C$ to $+60^{\circ}C$.

(b) Ageing. $\pm 5 : 10^{9}$ over any 24 hour period, after 30 days.

Optional version (Racal Type 9420):

(a) Frequency variation with temperature.
$\pm 6 : 10^{10}/^{\circ}C$ over temperature range $-10^{\circ}C$ to $+60^{\circ}C$.

(b) Ageing. $\pm 5 : 10^{10}$ over ony 24 hour period, ofter 30 doys.

Provision is mode for the use of an externol frequency stondord.

Modes of Emission:

USB/LSB (A3A, A3J)
Compatible AM (A3H)
ISB (A3B)
MCW (A2H, in USB or LSB)
CW (A1 or A2J in USB or LSB)
Optional: RTTY (F1) (tone shift keying in selected sideband)

Power Output: 200mW max. into 50 ohm load. Power variation not more thon ± 1dB over the frequency range. Power output is adjustable between 25mW and 200mW.

Corrier Suppression: The carrier levels related to modes are:-

(a) -6dB ± 1dB (A3H)
(b) -16dB ± 1dB (A3A)
(c) -26dB ± 1dB (A3A)
(d) Not less than -40dB (A3J)
(e) Tune -6dB ± 1dB (preset)

relative to p.e.p.

Unwanted Sideband Suppression: -50db relative to p.e.p.

Audia Input Level:	-30dB to +10dBm into 600 ohm balanced, by preset adjustment.	
Audia AGC:	An audia input variation af ± 10dB relative ta an input signal between -20dBm and 0dBm produces a change in output level not greater thon 2dB.	
A.F. Response:	Standard	Not greater than 4dB below peak response fram 300Hz to 3000Hz.
	Optional	Not greater than 4dB below peak response from 300Hz to 6kHz.
Intermodulation Praducts:	Better than -50dB relative to either one of two equal tones in a standard two-tone test.	
Hum:	Better than -50dB relative to p.e.p. in one sideband.	
Single Frequency Spurious Emissians:	Better thon -53dB relative to p.e.p.	
Harmonic Radiatian:	Better than -30dB relative to p.e.p.	
Inband Noise:	Better than -50dB relative to p.e.p. in a 3kHz bandwidth.	
Wideband Noise:	Better thon -100dB relotive to p.e.p. in o 3kHz bandwidth 500kHz off tune.	
Mute:	Better than -70dB below p.e.p. in o 3kHz bandwidth.	
RTTY Keying Input:	5V-0-5V to 80V-0-80V from external source. Input impedance greater thon 10kohm. Sense reversol possible by internol linkoge.	
Frequency Shift:	170Hz to 850Hz by preset odjustment, centred on 2kHz offset from the nominal corrier frequency. Centre frequency stability is within 2% of total frequency deviation.	
Telegraph Distortion:	Nat greoter than 5%.	
CW/MCW/Keying Input:	Operotion by contact closure.	
CW/RTTY Keying Rate:	200 bauds maximum.	
CW On/Off Rotio:	Better than -55dB relative to p.e.p.	
Extended Control:	Maximum operating loop impedance 200 ohms.	
Meters:	A meter is provided on the front panel to indicate line inputs, input setting levels, RF output and internal supply voltages.	
Terminotions:	Front Panel:	Twa sockets for audio input, microphone inputs or monitoring.
		Connector for test equipment to for RF output.

Terminations:	Rear Panel:	Supply input with voltage selector panel.
		Two audio inputs.
		Keying input. Loop keying connections.
		RTTY input.
		RF output.
		External frequency standard input.
		Extended and Remote control connectors.
		Receiver muting and/or antenna switching from two sets of contacts on internal relay.
		Receiver input for monitoring purposes.
		Amplifier control (Supply On, Coarse Tune Initiate, Ready, Mute, Reduced Power, Reset/Fault).
		Earth Connection.
Controls.	1. Supply:	Push button, illuminated when power ON.
	2. Standby:	Push button, illuminated when ON.
	3. EHT/Ready:	Push button, illuminated when associated amplifier is READY.
	4. Reset/Fault:	Push button, illuminated when drive unit is out of lock or amplifier fails.
Frequency Setting:	6 digit thumbwheel selector switch. (Local Control)	
Tune/Mute/Operate Switch:	Tune - Supplies a pre-set carrier level for tuning	
	Mute - Mutes drive unit and associated amplifier	
	Operate (Low -	Low Power, approx. 6dB below p.e.p. by adjustable internal preset control.
	(High -	Full Power.
Control Selector Switch:	Selects:	Local Synthesizer = (SYNTH)
		Local Programmer = (PROG)
		Extended = (EXT)
		Remote = (REMOTE)

Mode Selector Switch:	Switch: SSB, -6dB, -16dB, -26dB, suppressed carrier.
	ISB, -6dB or -26dB carrier.
	Key, -6dB or suppressed carrier.
	A.M. -6dB carrier.
	RTTY Test - Selects 'Mark'
	RTTY - Tone Shift keying
	CW - Selects LSB mode with 1kHz keyed tone. Operating frequency manually reset by adding 1kHz on the thumbwheel switch.
Sideband Selector Switch:	Selects Upper or Lower Sideband.
VOX/PTT/Transmit Switch:	VOX - Automatic Voice Switching.
	PTT - Press to talk.
	Transmit - Continuous transmission.
Meter Switch:	Measure Line input levels, setting line amplifier levels, RF output and internal supply voltages.
Line Input Levels:	Two front panel preset controls for setting audio input to the centre of the a.g.c. control range.
Indicator Lamps:	Supply ON, In-Lock — Drive Unit
	Standby, Ready, Reduced Power, Reset/Fault — From associated Amplifier
Power Supplies:	100 -125V a.c.
or	200 - 250V a.c.
	45 - 60Hz
	Consumption 70VA approximately.

Control Facilities:

Local
Extended via multicore cable ond the MA.1040 Remote Control Panel.
When used with the MA.1038 Pre-progrommed Selector the MA.1720 moy be operated on any one of six (MA1038A) or ten (MA1038B) pre-selected channels.

Remote via suitoble Remote Control System e.g. Rocol CSA1505 or the LA7922/LA7923 Remote Control System in conjunction with the MA1038 Pre-progrommed Selector and the MA.1040 Remote Control Panel.

Dimensions:

Height	178mm (7in)
Width	483mm (19in)
Depth	508mm (20in)
Weight	19,5kg (42.9lb)

Environment:

Temperature Operating -10°C to +55°C
Temperature Storoge -40°C to +70°C
Relative Humidity 95% at +40°C

The equipment is suitoble for air transportation in unpressurized conditions and for operotion ot oltitudes of 3000 metres above sea level; it is also suitable for transportable and moritime mobile operation ond meets certain clauses of British Defence Specification DEF 133 Table L2. In general the parameters in this specification are measured in accordance with CCIR and IEC recommendations.

VARIANTS OF TRANSMITTER DRIVE UNIT MA.1720

The following details describe briefly the differences between the various types of MA.1720.

MA.1720A: Standard version Transmitter Drive Unit. Synthesized 1MHz to 30MHz in 100Hz steps, USB/LSB (A3A, A3H, A3J), ISB (A3B), compatible AM (A3H), MCW (A2H, A2J), CW (A1). Capable of local (synthesized or pre-programmed), extended and remote control. Includes Type 9400 frequency standard and 300Hz to 3000Hz filter.

MA.1720B: As MA.1720A but with RTTY (F1) included.

MA.1720C: As MA.1720A but with 300Hz to 6000Hz filter.

MA.1720D: As MA.1720B but with 300Hz to 6000Hz filter.

MA.1720E: As MA.1720A but with Type 9420 Frequency Standard.

MA.1720F: As MA.1720B but with Type 9420 Frequency Standard.

MA.1720G: As MA.1720C but with Type 9420 Frequency Standard.

MA.1720H: As MA.1720D but with Type 9420 Frequency Standard.

MA.1720L: As MA.1720A but with 300 - 6000Hz filter and RTTY (F1), and less frequency standard.

MA.1720M: As MA.1720A but with marine 2.7kHz USB filter, and less audio A.G.C.

MA1720S 3·1 kcfs wide filters ?

CHAPTER 1

GENERAL DESCRIPTION

INTRODUCTION

1. The MA.1720 is a solid state Transmitter Drive Unit providing 289,999 frequency channels in 100Hz steps over the frequency range 1MHz to 30MHz. The output frequency is derived by frequency synthesis from a highly stable crystal-controlled 5MHz reference source. Channel frequency is selected by six thumbwheel switches which display the selected frequency in digital form; no other tuning action is necessary. 'Locking-in' to the selected frequency is completed in approximately 10 milliseconds; a front panel indicator illuminates when the MA.1720 is in 'lock' i.e. when the tuning sequence is completed.

2. The output level of the unit may be preset by internal control from 25mW to 200mW; the output impedance is 50 ohms.

3. Local, pre-programmed, extended or remote control of the associated transmitter is selected by a front panel switch on the Drive Unit.

LOCAL (SYNTH)	-	The transmitter is controlled by the front panel settings on the MA.1720.
LOCAL (PROG)	-	The MA.1720 may be operated on pre-selected frequency channels by means of a pre-programmed selector such as the Racal MA.1038.
EXTENDED	-	Control of the MA.1720 and the associated transmitter is extended to an external control panel such as the Racal MA.1040.
REMOTE	-	Control of the MA.1720 and the associated transmitter is extended to a remote control position over telephone lines or radio links by means of a remote control system such as the Racal CSA 1505 or LA 7922/7923 and the MA.1040 Remote Control Panel.

AUDIO/KEYING INPUTS

4. Two front panel jacks are provided for connection and monitoring of line inputs, connection of a microphone or contact closure keying. LINE 1 jack is used for USB or ISB modes and both jacks are used for ISB operation; contacts are also provided on LINE 1 jack for a Press-to-Talk line, sidetone output, and connection of an output from an associated receiver. Rear panel connectors provide for connection of two 600 ohm balanced line inputs, a high impedance R.T.T.Y. input, telegraph keying and external frequency standard

ant

input. Multi-way connectors enable the extended, remote or pre-programmed control facilities to be connected to the MA.1720.

5. The 600 ohm balanced audio inputs may vary between -30dBm and +10dBm (relative to 1mW); two front panel controls enable the input level to be set to the centre of the a.g.c. range. The optional RTTY facility is provided by an internally fitted module; the RTTY keying input may vary between 5-0-5 volts and 80-0-80 volts provided by an external supply; maximum keying speed is 200 bauds.

NOTE: For polar or neutral keying input, a second optional board (PS567) may be fitted. See Appendix 2 for details.

OPERATIONAL FACILITIES

6. The unit offers a choice of upper or lower single sideband, with suppressed or reduced carrier, independent sideband or radio telegraphy. Radio teleprinter (RTTY) is available as an optional built-in facility. Details of the facilities which are selected by a front panel control switch are as follows:

SSB (Upper or Lower)	-26, -16dB or suppressed.
ISB	-16 or -26dB carrier
Key	-6dB or suppressed carrier
A.M.	-6dB carrier
C.W.	L.S.B. mode with 1kHz keyed tone
RTTY	Tone Shift Keying
RTTY Test	Selects Mark
VOX	Automatic Voice Switching
PTT	Press-to-Talk
Transmit	Continuous transmission

NOTE: The -26dB pilot carrier level may be changed to -20dB by a simple modification (see Figure 11).

7. Vox (automatic voice switching) is available on Line 1 to enable two way conversation to be carried out without manual switching.

8. To increase the flexibility of any system in which the MA.1720 Drive Unit may be employed, provision is made for muting an associated receiver and for antenna switching between the associated transmitter and receiver. The receiver output may be monitored at the drive unit and the drive unit sidetone fed to the receiver.

FRONT PANEL CONTROLS

9.

(1) SUPPLY switch: Push button switch.

(2) Frequency Selector Switches: 6 thumbwheel switches.

(3) MODE Selector Switch: An 11 position switch which selects the facilities described in para. 6.

(4) TUNE/MUTE/OPERATE Switch: A four position switch

TUNE: Provides a CW tuning signal for the associated transmitter.

MUTE: Mutes drive to transmitter.

OPERATE: Low: power operation approximately -6dB below p.e.p. by internal adjustment.

High: Full p.e.p. adjustment by internal preset control.

(5) Sideband Selector Switch: A two position switch which selects upper or lower sideband.

(6) VOX/PTT/TX Switch: A three position switch which selects

VOX - Automatic Voice Switching

PTT - Press-to-Talk

TX - Continuous transmission

(7) CONTROL Selectar Switch: A four position switch which selects local, extended, remote or pre-progrommed contral of the MA.1720 (refer to paro. 3).

FRONT PANEL INDICATORS

10.

(1) Supply: Illuminotes when power is 'on'.

(2) In Lock: Illuminotes when the drive unit is locked in to the selected frequency.

(3) Standby: Illuminotes when the associated transmitter is in the 'Standby' condition.

(4) Ready: Illuminates when the EHT is opplied to the associated linear amplifier.

(5) Reset: Illuminotes to indicote o foult in the associoted linear amplifier.

(6) Reduced Power: Illuminates when the linear amplifier is operating at reduced power.

MONITORING

11. The front panel jacks (LINE 1 and LINE 2) enable the audio line inputs to the drive unit to be monitored using high impedance headphones. LINE 1 monitors the Audio 1 input whilst LINE 2 monitors the Audio 2 input. The audio input from an associated receiver may also be monitored at LINE 1.

12. The signal input socket SK9, which is mounted on the rear panel, provides monitor facilities for Audio 1 and Audio 2 inputs and the output of an associated receiver. The associated receiver output may also be monitored at terminal strip TS1 at the rear of the unit.

13. An r.f. monitor socket mounted on the front panel permits connection of test equipment to monitor the r.f. output of the Drive Unit.

METERING

14. A front panel mounted meter is used in conjunction with the meter switch to indicate the line input levels, line input setting levels, the internal supply voltage and the r.f. output level. A green band on the meter scale indicates the correct setting for audio levels and internal supply voltages.

FREQUENCY STANDARD

15. The reference frequency is generated by a 5MHz Racal fast warm-up oscillator Type 9400 which has a stability better than 1 part in 10^8 over the temperature range -10°C to +60°C. The Racal Type 9420 5MHz oscillator, available as an option, has a stability better than 6 parts in 10^{10} over the temperature range -10°C to +60°C. A rear panel socket with associated switch provides for the use of an external 5MHz frequency is required.

MECHANICAL DETAILS

16. The unit is housed in a cast alloy chassis, which is compartmented to provide screening between assemblies liable to mutual interference. The printed circuit boards are mounted on either side of the chassis.

17. Access to assemblies mounted on the upperside of the chassis is gained simply by removing the top panel which is secured by screws to the side and rear panels. Assemblies mounted on the underside of the chassis are protected by individual lids which afford easy access to each assembly. The printed circuit boards mounted on the underside of the chassis may be hinged outwards from the chassis for servicing purposes.

18. The front, side and rear panels are all constructed of metal; the rear panel carries the heat sinks for the power transistors. The front panel is connected to the main cableform via two multi-pin connectors and may be removed from the chassis for test purposes.

19. To facilitate cooling, slots in the chassis, the top cover, and compartment lids allow air to flow freely throughout the unit.

PRINCIPLES OF OPERATION

Fig. 1

Single Sideband Operation

20. The modulating input signals are applied to the balanced modulator via the Automatic Gain Control amplifiers. The outputs of the A.G.C. amplifiers are switched by reed relays which are controlled by the setting of the front panel Mode Selector Switch. In the SSB mode, Channel 1 input is used to generate the SSB upper or lower sideband whilst Channel 2 input is used to generate the lower sideband in the ISB mode.

21. The audio outputs from the A.G.C. amplifiers are mixed, in the balanced modulators, with the 1.4MHz output from the frequency synthesizer; the required sidebands are obtained by filtering. The output from Balanced Modulator 1 is applied to the LSB filter and the output from Balanced Modulator 2 is applied to the USB filter, to compensate for sideband inversion which occurs in the final mixer.

22. The 1.4MHz signal from the synthesizer is also applied to a carrier insertion stage where it is attenuated by 6, 16 or 26dB (suppressed carrier greater than -40dB), dependent upon the mode of emission selected; the audio input from the A.G.C. amplifiers is also attenuated to ensure a constant p.e.p. output. A summing amplifier adds the SSB or ISB signals to the carrier and the resultant signal is mixed with the 34MHz output from the synthesizer to produce an i.f. of 35.4MHz.

23. The 35.4MHz i.f. is fed, via a bandpass filter which attenuates the unwanted image signal, to a wideband amplifier. The output of the wideband amplifier is applied to a crystal filter which has a pass-band of $\pm$6kHz centred on 35.4MHz; the filter reduces noise to the final mixer to obtain optimum wideband noise performance.

24. In the final mixer, the 35.4MHz i.f. is mixed with the 36.4MHz to 65.4MHz output from the synthesizer, and the resultant output is applied to a low pass filter which suppresses the image signal and oscillator breakthrough, to produce the output frequency in the range 1MHz to 30MHz. The output of the low pass filter is applied via a buffer amplifier, which incorporates a manual gain control, to a five stage wideband amplifier.

25. The exact output frequency of the Drive Unit is determined by the frequency setting of the synthesizer which is controlled by the setting of the thumbwheel switches on the front panel.

Suppressed Carrier Operation

26. Suppressed Carrier Operation is similar to Single Sideband Operation, the difference being that the required sidebands have been generated.

Frequency Synthesis

27. In the frequency synthesizer the 1.4MHz output is obtained by dividing the output from the 5MHz frequency standard to 200kHz and applying the resultant square waveform to a 1.4MHz crystal filter and tuned amplifier.

28. The 34MHz signal is derived from the 34MHz voltage controlled oscillator. The control voltage for the oscillator is obtained from a detector circuit which compares a divided output from the oscillator with a divided output from the 5MHz frequency standard, thus ensuring that the oscillator is accurately locked to 34MHz.

29. The 36.4MHz to 65.4MHz variable frequency output is obtained by synthesis of a number of frequencies, all of which are derived from the 5MHz frequency standard; a general description is given in Appendix 1.

CHAPTER 2

INSTALLATION

INTRODUCTION

1. Installation af the Drive Unit consists af making electrical connections to sackets on the frant and rear panels as detailed in the following paragraphs.

FRONT PANEL CONNECTORS

2. Two front panel jack sockets provide the following:

FUNCTION	CONNECTOR
Audio injectian SSB (USB and LSB)	Line 1 jack
Audia injectian ISB (USB)	Line 1 jack
Audio injection ISB (LSB)	Line 2 jack
Press-to-talk	Line 1 jack
Contact closure keying	Line 1 or Line 2 jack
Monitor audio input SSB (USB or LSB)	Line 1 jack
Monitor oudio input ISB (USB only)	Line 1 jack
Monitor audio input ISB (LSB only)	Line 2 jack
Monitor keying inputs	Line 1 jack
Monitor RTTY inputs	Line 1 jack
Monitor associated receiver output	Line 1 jack

Details of cannections to LINE 1 and LINE 2 jacks are as follows:

Jack Contact No.	Function
1	Associated receiver output (Line 1 jack only)
2	See Note (3) (Line 1 jack only).
3	See Note (2).
4	Cannect to pin 8 if microphone bias required.
5	Monitor audio, keying or RTTY sidetones.
	Press-to-talk (line 1 jack only) normally is not re[illegible]en contacts between pin 6 and pin 7.
	[illegible]e to pin 4 if microphone bias required.
	Not used.

Jack Contact No.	Function
10	Not used.
11	One of key contacts (other to earth)
12	Local audio injection
13	Common 0V

Note: (1) To connect a jack plug to a jack socket, the plug is pushed in and turned fully clockwise. The socket is slotted to accept the plug in one position only. To remove the plug, reverse the above procedure.

(2) To monitor the a.f. input with a headset plugged into a jock socket whilst applying the a.f. input to TS1 at the rear of the unit (refer to paragraph 11) connect pin 3 to pin 12 in the jack plug.

(3) To monitar the key input with a headset plugged into a jack socket whilst applying key input to TS1 at rear of the unit (refer to para.11), connect pin 2 to pin 11 in the jack plug.

REAR PANEL CONNECTORS

3. The following connectors ore provided on the rear ponel:

PL2 Supply input - connect local o.c. supply to unit.

PL3 Extended frequency control lines - enobles frequency to be selected from an extended position; olso provides power ond indicator connections to the Pre-programmed Selector. D 37 M

SK2 Extended/remote control lines - enables the MA.1720 to be controlled from an extended or remote position. D 37 F

SK3 External frequency stondord input - enables the frequency synthesizer to be referenced to o 5MHz external frequency source. B N C

SK4 Output - connects the r.f. output of the MA.1720 to the ossaciated transmitter. B N C

SK6 Status/control lines to transmitter - enables the MA.1720 to control a distont linear amplifier. D 15 F

SK9 Signal inputs - connects modulating inputs to the drive unit. D 25 F

TS1 Signal inputs - connects modulating inputs to the drive unit. CONNECTOR BLOCK

(300mA m

PL2 - Supply Input

4. Mains power supplies are connected to PL2 as follows:

Line - Pin A
Neutral - Pin B
Earth - Pin C

Note: The associated voltage tapping panel should be adjusted to suit the local mains voltage.

PL3 - Extended Frequency Control Lines, Power, and Indicator Connections

5. The frequency of the Drive Unit may be controlled externally by applying +12V to the extended frequency control lines according to the following code (see para.6

Note: (1) +12V is available at PL3 pin 37.

(2) The external frequency control lines may also be used as outputs, where the frequency is selected on the MA.1720 frequency switches and an external indication is required. In this case, the output is the same code and voltage levels as the input.

6. Coding

(a) The 100Hz, 1kHz, 10kHz, and 100kHz inputs are in inverted 1-2-4-8 BCD, e.g.

600Hz = 0110 (x 100Hz decade), which when inverted becomes 1001, where 1 = +12V, and 0 = open circuit.

(b) The 1MHz and 10MHz inputs are in inverted nines complement code, e.g.

6MHz nines complement = 3MHz.

3MHz = 0011 (x 1MHz decade) which when inverted becomes 1100, where 1 = +12V, and 0 = open circuit. Using the above examples, the following table shows how inputs or outputs would be for a frequency of 06.000600MHz.

EXTENDED FREQUENCY CONTROL LINES

	Pin	Function		Remarks	
TB10 9	9	1			1
10	10	2	x 100Hz		0
11	11	4			0
12	12	8			1
TB10 5	5	1			1
6	6	2	x 1kHz		1
7	7	4			1
8	8	8			1
TB10 1	1	1		Inverted BCD	1
2	2	2	x 10kHz		1
3	3	4			1
4	4	8			1
TB11 9	21	1			1
10	22	2	x 100kHz		1
11	23	4			1
12	24	8			1
TB11 5	17	1			0
6	18	2	x 1MHz		0
7	19	4			1
8	20	8		Inverted Nines Complement	1
TB11 1	13	1			0
NC	14	2	x 10MHz		1
NC	15	4			1
TB11 5	16	8			0

Example given in para. 6.

POWER AND INDICATOR CONNECTIONS

	Pin
Pre-programming (+12V d.c. level indicates that the MA.1720 is set to Pre-programmed control)	36
0V	
12V (max.) Supply to Pre-programmed Selector	37

SK2 - Extended/Remote Control Lines

7. Input and output connections for extended and remote control are made to SK2. Input connections are applied at +12V d.c. to select a mode of operation (open circuit = off) and output connections at +12V d.c. illuminate indicating lamps on the extended or remote control panel. Pin connections and functions are given below:

Bottom back panel connectors.

EXTENDED/REMOTE CONTROL LINES

Pin	Function	Pin	Function
1	Blank	20	Blank
2	Blonk	21	RTTY
3	ISB Control	22	LSB control
4	Blank	23	Low power control
5	High Power control	24	-26dB control
6	-16dB control	25	-6dB control
7	Key supp. control	26	Key -6dB control
8	Vox control	27	Blank
9	Extended Tx lamp	28	Extended 'EHT ON'
10	Extended 'Reset'	29	Extended 'Standby ON'
11	Extended 'Tune'	30	Extended 'Reset' lamp
12	Extended 'Reduced' power lamp	31	Extended 'Ready' lamp
13	Extended 'In lock' lamp	32	Extended Mute
14	Remote ON	33	Extended ON
15	Extended Mode Control	34	Extended 'PTT'
16	-7V	35	0V
17	+5V	36	+12V
18	+20V	37	Remote 'PTT'
19	Local 'PTT'		

AF input TB16 1 +
TB16 2 -
TB16 3 scr

SK3 - External Frequency Standard Input

8. An external 5MHz frequency standard with a minimum output level of 300mV r.m.s. may be connected to SK3. The adjacent slide switch selects either internal or external standard as the reference frequency for the synthesizer.

Key input TB16 7 +
TB16 8 earth

SK4 - Output

9. SK4 is the output socket for the 1MHz to 30MHz modulated output of the drive unit.

SK6 - Status/Control Lines to Amplifier

10. SK6 carries the status signal and control interconnections between the drive unit and the associated amplifier. Pin connections and functions are given below.

STATUS/CONTROL LINE

Pin No.	Function	Voltage	Action
1	Mains On	+12V = ON 0V = OFF	Signal present when MA.1720 is switched on.
2	Fault	0V = Fault +12V = Normal	Lights the 'Reset' lamp and mutes the MA.1720 under fault conditions.
3	Ready	0V = Ready +12V = Not ready	Lights the 'Ready' lamp, the absence of the 'Ready' signal reverts the output of the MA.1720 to the 'tune' signal.
4	Reset (Coarse Tune Initiate)	0V = Normal +12V = Reset	When the 'Reset' button is depressed the MA.1720 is de-muted and a coarse tune initiate signal is applied to the linear amplifier.
5	Reduce Power	0V = Lamp Off +12V = Lamp On	Lights 'Reduced Power' lamp when the linear amplifier is operating on the reduced power.
6	EHT ON	+12V = OFF 0V = ON	Switches on linear amplifier EHT supplies.
7	Standby	+12V = OFF 0V = ON	Sets the linear amplifier to Standby.
8	Mute	+12V = Normal 0V = Mute	Mutes linear amplifier.
9		0V	Earth
10	Not used.		
11	Coarse Tune Initiate (Reset)	0V = No +12V =	Set linear amplifier to the coarse tune condition.

FOR RF [illegible]

LINK PIN 9 to 3
& PRESS RESET GIVES 2 WATTS RF

SK9/TS1 - Signal Inputs

11. Signal inputs to the drive unit may be connected to SK9 or TS1 which are connected in parallel. Connections and functions are given below.

Signal Input Socket SK9

Pin	Function	Pin	Function
1)	Audio 1 input	25	Screen for RTTY input
2)		15	Blank
14	Screen for Audio 1 input		
3)	Audio 2 input	19	Audia 1 monitor (Sidetone)
4)		20	Screen for Audio 1 monitor
16	Screen far Audio 2 input	21	Audio 2 monitar (Sidetone)
TB16 (7) 5	KEY input	22	Screen Audio 2 monitor
17	Screen for Key input	23	0V
6	Audio from Receiver	24	+12V
18	Screen for Audio from Receiver		
7	Normally Closed (Tx Condition)		
8	Relay contacts (Change Over)		
9	Normally Open		
10	Normally Closed		
11	Relay contacts (Change Over)		
12	Narmolly Open		
13	RTTY input		

See Nate on next page.

Signal Input Terminol Strip TS1

Pin	Function	Pin	Function
1)	Audia 1 input	10	Normally Clased) See Note below
2)		11	Relay contacts)
3	Screen for Audio 1 input	12	Normally Open)
4)	Audio 2 input	13	Key input
5)		14	Screen far Key input
6	Screen for Audio 2 input	15	Audia input fram Receiver
7	Normally Clased	16	Screen far Audio input from Receiver
8	Relay Contacts (Change Over)) See Note below	17	RTTY input
		18	Screen far RTTY input
9	Normolly Open)	19	0V
		20	+12V

Note: Pins 7 to 12 inclusive of Socket SK9 and Terminal Strip TS1 are connected to a changeover relay in the MA.1720 which is provided for external use only. This relay operates when the output of the MA.1720 is muted.

Local Operation

12. The CW output (pin 2 on the RTTY board - PM340) should not be linked to the associated pin (pin 2) on the mounting plate. This link is made for remote operation only.

Remote Operation

13. Both RTTY and CW inputs are fed to pins 13 and 25 of SK9, or pins 17 and 18 of TS1 (RTTY INPUT). When the RTTY board is not fitted, pins 2 and 3 on the RTTY board mounting plate must be linked.

Front Panel to Main Chassis Connections

14. So that the front panel may be detached from the main chassis, the wiring from the front panel switches, connectors, and indicators are terminated in a 37-way socket (SK1) and a 37-way plug (PL1), mounted on the rear of the front panel. These connectors mate with PL1 and SK1 respectively, on the main chassis cablefarm (refer to figs. 23 and 28).

CHAPTER 3

SETTING-UP AND OPERATION

INTRODUCTION

1. The MA.1720 Drive Unit and associated transmitter may be controlled by any one of the following methods:

   (a) Local Control - The Drive Unit and associated linear amplifier are controlled by the setting of the front ponel switches.

   (b) Extended Control - The Drive Unit and associated linear amplifier are controlled by switches on an external panel (e.g. Racal MA.1040).

   (c) Remote Control - Full operational control of the Drive Unit and ossociated linear amplifier is extended to a remote cantrol terminal vio telephone lines or radio links by means of a remote control system such as the Racal CSA.1505 ar LA7922/7923 and the MA.1040 Remote Control Panel.

   (d) Pre-progrommed Control - The frequency of the Drive Unit is controlled by a Pre-Programmed Selector such as the Racal MA.1038 which may be set to provide a number af frequency channels.

2. Detailed operoting instructions are given in paras. 40 to 51.

INITIAL SETTING-UP

3. The setting-up procedures detailed in the following paragraphs need only be carrie out immediately following installation or maintenonce.

4. Check that the voltage selector on the rear panel is set correctly for the local mai voltoge and that the slider switch on the rear panel is set correctly for internal or externol frequency standard.

5. If RTTY operation is required, connect the link LK1 on the RTTY Generator Board PM340 as follows:-

   Link A-B for Normol Keying
   Link A-C for Reverse Keying

Note: If Polor or Neutral Keying is required, board PS567 must be fitted in addition to board PM340. Details af PS567 are to be found in Appendix 2.

6. Set the front panel switches as follows:

SUPPLY switch to OFF
STANDBY switch ta OFF
EHT switch ta OFF
TUNE/MUTE/OPERATE switch ta OPERATE HIGH
MODE SELECTOR switch to RTTY TEST
CONTROL SELECTOR switch ta LOCAL

7. Operate the SUPPLY push-button and check that the fallawing lamps illuminate:

SUPPLY ON
RESET
IN LOCK

8. Set the meter switch in turn ta -7V, +5V, +12V and +20V. Check that on each setting the meter reads in the centre of the green band an the meter scale; if not refer to Chapter 5, para.2.

INITIAL CHECKS

9. Befare installation, functionol and mode checks of the MA.1720 may be carried out using a multimeter and the front panel mounted meter. To simulate transmitter conditions, variaus inputs must be applied to socket SK6 on the rear panel of the unit; detoils are given in paras.10 ta 29.

Functionol Checks Using Multimeter

10. Ensure the r.f. output of the MA.1720 (SK4 on the rear panel) is connected to a 50 ohm load.

11. At socket SK6 on the rear panel connect pin 9 ta pin 3; this simulates the READY conditian in the absence of a linear amplifier.

12. Select an operating frequency on the thumbwheel switches and press the RESET button. When the RESET lamp extinguishes the Drive Unit is de-muted, and when the IN LOCK lamp illuminates the Drive Unit is locked to the selected frequency. Set the meter switch to R.F. and ensure there is a reading of appraximately 200mW on the meter.

13. Connect the multimeter (set to measure d.c. volts) between pin 7 of socket SK6 on the rear panel and earth (+ve lead ta pin 7). Check that the multimeter measures +12V d.c. Press the STANDBY push-button and check that the multimeter reads 0V.

14. Connect the multimeter between pin 6 of socket SK6 and earth (+ve lead ta pin 6). Check that the multimeter measures +12V d.c. Press the EHT push-button and check that the multimeter reads 0V.

15. Apply +12V d.c. to pin 5 of socket SK6 to simulate a linear amplifier operating on reduced power and check that the REDUCED POWER lamp illuminates.

NOTE: +12V d.c. is available on pin 36 of socket SK2.

16. Remove the +12V d.c. from pin 5 of socket 6 and connect the multimeter between pin 8 of socket SK6 and earth (+ve lead to pin 8). Check that the multimeter reads +12V d.c. Set the TUNE/MUTE/OPERATE switch to MUTE and check that the multimeter reads 0V. Reset the TUNE/MUTE/OPERATE switch to OPERATE HIGH.

17. Connect the multimeter between pin 4 of socket SK6 and earth (+ve lead to pin 4) and press the RESET push-button. Check that the RESET lamp extinguishes and that the multimeter reads +12V d.c.

18. Apply 0V to pin 2 of SK6 to simulate a transmitter fault, and check that the RESET lamp illuminates.

19. Press the RESET push-button and check that the Drive Unit de-mutes for 2 seconds before the RESET lamp illuminates again.

20. Restore the +12V d.c. connection to pin 2 of socket SK6 and check that the Drive Unit is de-muted and the RESET lamp is extinguished.

Mode Checks

21. Set the MODE SELECTOR switch to AM-6, the Vox/PTT/Tx switch to Tx, and the TUNE/MUTE/OPERATE switch to OPERATE low, and check that the r.f. output of the Drive Unit decreases by 6dB.

22. Set the MODE SELECTOR switch to SSB SUPPRESSED, connect a suitable microphone to LINE 1 jack and check that speech input to the microphone modulates the r.f. output of the Drive Unit.

23. Set the TUNE/MUTE/OPERATE switch to MUTE, and the MODE SELECTOR switch to AM-6. Check that the Drive Unit is muted when speech is applied to the microphone.

24. Set the TUNE/MUTE/OPERATE switch to OPERATE HIGH, and the Vox/PTT/Tx switch to Vox. Check that when speech input to the microphone is stopped for more than 2 seconds the Drive Unit is muted.

25. Switch the Vox/PTT/Tx switch to PTT and check that the Drive Unit is muted when the pressel switch on the microphone is not operated.

26. Remove the microphone from LINE 1 jack and set the MODE SELECTOR switch in turn to ISB-16, ISB-26, SSB SUPPRESSED, SSB-26, SSB-16, and AM-6. Check that the r.f. output of the Drive Unit varies in accordance with each mode selected.

27. Switch the MODE SELECTOR switch in turn to CW, KEY SUPPRESSED, and KEY-6. Check that the r.f. output level varies in accordance with each mode selected.

28. Connect a suitable test key to LINE 1 jack and switch the MODE SELECTOR switch in turn to CW, KEY SUPPRESSED and KEY-6. Check that in the 'key down' condition at each switch position the r.f. output of the Drive Unit is approximately 200mW.

29. Remove the connections to pin 2 and pin 3 of socket SK6.

Functional Checks: MA.1720 Connected to a Linear Amplifier

30. The functional checks described in the following paragraphs should be made with the MA.1720 connected to a suitable linear amplifier (e.g. Racal TA1800) as detailed in Chapter 2.

31. Select an operating frequency on the thumbwheel switches and press the RESET button. When the RESET lamp extinguishes the Drive Unit is de-muted (not muted) and when the IN LOCK lamp illuminates, the Drive Unit is locked to the selected frequency. Set the meter switch to RF and ensure that the level is suitable for the associated linear amplifier e.g. 100mW with the TA.1800. Refer to the linear amplifier handbook for RF input levels.

32. Press the STANDBY ON push button and check that the associated linear amplifier is switched to the 'standby' condition and that the STANDBY ON lamp illuminates. Press the EHT push button and check that the EHT supply signal is applied to the linear amplifier and the READY lamp illuminates.

33. Check that operation of the EHT ON/OFF switch on the linear amplifier illuminates and extinguishes the READY lamp.

34. If possible, check that when the linear amplifier is operating on reduced power, the REDUCED POWER lamp on the MA.1720 illuminates.

35. Restore the linear amplifier to normal operation, set the TUNE/MUTE/OPERATE switch to MUTE and check that the MA.1720 and linear amplifier are muted. Reset the TUNE/MUTE/OPERATE switch to OPERATE HIGH.

36. Press the RESET push button and check that the RESET lamp extinguishes and that the linear amplifier is de-muted.

37. If possible, simulate a fault condition on the linear amplifier (e.g. break the interlock line) and check that the RESET lamp illuminates and that the Drive Unit is muted.

38. Operate the RESET push button and check that the Drive Unit de-mutes for 2 seconds before the RESET lamp illuminates again.

39. Restore the transmitter to normal operation, check that the Drive Unit is de-muted and the RESET lamp is extinguished.

OPERATING PROCEDURES

40. The operating procedures detailed in the following poragraphs assume that the MA.1720 has been connected to a suitable linear amplifier (e.g. Racal TA.1800) as detoiled in Chapter 2.

Locol Control

41. (a) Press the SUPPLY push button ond check that the SUPPLY lamp illuminates.

(b) Set the CONTROL switch to SYNTH.

(c) Set the TUNE/MUTE/OPERATE switch to OPERATE HIGH or LOW as required.

(d) Set the MODE SELECTOR switch to mode of emission required.

(e) Set the SIDEBAND SELECTOR switch to UPPER or LOWER as required.

(f) Set the Vox/PTT/Tx switch as required.

(g) Select the required frequency on the FREQUENCY SELECTOR thumbwheel switches and check thot the IN LOCK lamp illuminates.

(h) Press the STANDBY push button ond check thot the STANDBY lamp illuminotes.

(j) Press the EHT push button and check that the READY lomp illuminotes when the lineor omplifier (TA.1800) has completed tuning.

(k) Press the RESET push button. When the RESET lomp extinguishes the MA.1720 and associated transmitter are ready for operation.

42. After o frequency change, note the state of the RESET lomp ond press the RESET button if the lamp is illuminoted.

43. Monitoring may be carried out as detoiled in paras. 52 to 54.

44. If SSB mode is selected, the audio input levels must be set as follows:-

(a) With AGC: Set the meter switch to SET 1 and adjust the SET LINE 1 potentiometer to obtoin a meter reading of 0dB (with a continuous tone audio input).

(b) Without AGC: As for para. 44(a) but with a meter reading of -10dB.

45. If ISB mode is selected, repeat para. 44 for LINE 2.

Extended Control

46. Control of the MA.1720 and associated linear amplifier is extended to an external control panel, the operation of which is similar to Local Control operation described in paras.41 and 42. On the MA.1720, the SUPPLY must be switched ON and the CONTROL switch set to EXT.

47. Local manitoring may be carried out as detailed in paras.52 to 54.

Remote Control

48. Control of the MA.1720 and associated linear amplifier is extended to a remate control terminal via telephone lines or a radio link by means of a remote control system. The MA.1720 SUPPLY must be switched ON and the CONTROL switch set to REMOTE.

49. Local monitoring may be carried out as detailed in paras.52 to 54.

Pre-Programmed Control

50. Control of frequency selection only is extended to a Pre-Programmed Selector in which the frequency channels are pre-set on thumbwheel switches. All other front panel controls on the MA.1720 must be operated as for Local Operation described in paras. 41 and 42 and the CONTROL switch must be set to PROG.

51. Monitoring may be carried out as detailed in paras.52 to 54.

MONITORING

52. The inputs to the MA.1720 may be monitored using high impedance headphanes as detailed below:

Facility	Connector
Monitor audio input SSB (USB or LSB)	Line 1 jack
Monitor oudio input ISB (USB only)	Line 1 jack
Monitor audio input (LSB only)	Line 2 jack
Monitor keying inputs	Line 1 jack
Monitor RTTY inputs	Line 1 jack
Monitor associated receiver output	Line 1 jack

53. The audio inputs to the Drive Unit moy also be monitored at socket SK9 which is mounted on the rear panel. Details are as follows:-

Facility	SK9 Pin No.
Audio 1 monitor	19
Screen for audio 1 monitor	20
Audio 2 monitor	21
Screen for audio 2 monitor	2

54. A front panel mounted meter and an associated meter switch pravide the following:-

Meter Switch Position	Meter Indication
LINE 1	Line 1 input level
LINE 2	Line 2 input level
SET 1	Line 1 input level (may be adjusted by front panel mounted potentiometer located above LINE 1 jack)
SET 2	Line 2 input level (may be odjusted by front panel mounted potentiometer located above Line 2 jock)
RF	RF output level
-7V	)
+5V	) Internal supply voltages. Correct level is indicated by meter
+12V	) reading in centre of the green
+20V	) band on the meter scale.

CHAPTER 4

CIRCUIT DESCRIPTION

INTRODUCTION

1. The drive unit may be broken down into a number of discrete stages, each stage being associated with either the frequency generating circuits (i.e. synthesizer) or the signal circuits (i.e. mixers, amplifiers, filters etc.).

2. A block schematic of the signal path is given in Fig.1 while Fig.2 shows a block schematic of the frequency synthesizer stages. Each diagram indicates the various stages included on each printed circuit board.

3. The constituent sub-circuits for the drive unit are as shown in para.5 and a detailed circuit description of each is given in succeeding paragraphs in this chapter.

4. To aid the user in a better understanding of the frequency generation circuits, a more general description of the basic concept of the method of frequency synthesis is included in Appendix 1.

5. The drive unit consists of the following stages, each of which (except for the 5MHz frequency source) is built on a printed circuit boord:-

(o) Frequency source (Racal Type 9400)

(b) 34MHz Generator Board PM344

(c) Frequency Synthesizer Board PM349

(d) Tronsfer Loop Board PS338

(e) HF Laop and Oscillotor Board PS337

(f) Low Level Board PM341

(g) RTTY Generotor PM340

(h) Mixer and Output Board PM342

(j) Noise Immunity Boord PM346

(k) Control Board PM345

(l) Power Supply Board PM343

FREQUENCY SOURCE

6. The internal frequency source is a Racal 5MHz crystal cantrolled oscillator Type 400. If an even more accurate source is required the Racal Type 9420

is available on option. Provision is made for connecting a suitable external frequency source to a socket on the rear panel; an adjacent slide switch selects internal or external source for use by the synthesizer.

34MHz GENERATOR BOARD PM344 Fig. 3

7. The main function of the 34MHz Generator Board is to produce a 34MHz sinewave output at a level of 0dBm. The board contains the fallawing circuits relevant to this function:-

(a) Nominal 34MHz oscillator with output buffers and filter.

(b) Divide-by-34 stage to produce a nominal 1MHz squarewave from one of the outputs of (a), for internal use on the board by the phase comparator.

(c) Amplifier and squarer for the 5MHz reference frequency input, followed by a divide-by-5 stage and output buffers.

(d) Phose detector circuits to compare the outputs of (b) and (c), and produce a control voltage for locking the frequency of (a) accurately on 34MHz.

8. Also contained on the board are logic circuits that receive inputs from the frequency-setting thumbwheel switches on the front panel, and produce control outputs for application to the appropriate oscillator selectar on the HF Loop Board.

34MHz Oscillator

9. TR2, TR4 ond associated components form a nominal 34MHz LC oscillator. L1, C1 and C3 form the basic tuned circuit; frequency pulling is provided by varactor diode D2. The control voltage for D2, applied via RF chake L2, is derived from the phase detector and voltage control circuit described in para. 15 and 16.

10 The output of the oscillator is buffered by 'nand' gates G1-G3 in ML1, for which the h.t. supply is provided by series regulator TR1 and zener diode D1. The squorewave output from gate G3 is fed to the low-pass filter including L4 and L5, and the resultant 34MHz sinewove output is taken off the board at pin 1. The output of gate G2 is applied as the clock input to the divide-by-34 stage.

Divide-by-34 Stage

11. The divide-by-34 stage consists of the dual J-K flip-flop ML3, the binary decade counter ML5 (connected as a divide-by-10 stage), and 'nand' gates G4 and G6 in ML6.

12. The 34MHz output from the buffer G2 in ML1 is applied in parallel to the clock inputs of both halves of ML3; the J1 output is held at logic '1' (+5V). The division factor of 34 is obtained by dividing the first 18 pulses by 3 and the next 16 pulses by 4.

i.e. 18 pulses ÷ 3 = 6

16 pulses ÷ 4 = 4

Therefore, for 34 pulses in, 10 pulses appear at the output of ML3. These 10 pulses are divided by ML5 to provide the 1MHz output at pin 2 of ML5.

13. Figure 4.1 illustrates the action of the circuit and shows the logic signals produced at relevant points.

Amplifier and Squarer

14. The 5MHz sinewave input from the frequency standard is fed onto the board at pin 8 and applied to the amplifier and squarer comprising TR3, TR5 and associated components. The output of this circuit is divided by 5 in ML2, the resulting 1MHz squarewave (0V to +4V p-p) is fed to the inputs of 'nand' gates G5, G7 and G8 (connected as buffers) in ML4. The output of G5 is taken from the board at pin 10 via a 220 ohm resistor to the Transfer Loop Board PS338 and the output of G7 is taken via pin 12 to the Synthesizer Board PM349. The output of G8 is applied as the reference frequency to one input of the phase detector.

Phase Detector

15. The phase detector comprises the dual D-type flip-flop ML7, 'nand' gate G9 on ML6, and the voltage control circuit TR6, TR7, TR8 and associated components. The nominal 1MHz squarewave derived from the 34MHz oscillator via the divide-by-34 stage is applied as the clock input to one half of ML7, and the reference 1MHz squarewave derived from the 5MHz frequency standard is applied as the clock input to the other half. Both D inputs are held permanently at logic 1. The Q outputs of both halves are applied to the inputs of 'nand' gate G9, and the output of G9 is connected back in parallel to the 'clear' inputs of both halves of ML7. The Q outputs are applied as control inputs to the voltage control circuit.

Voltage Control Circuit

16. The voltage control circuit comprises transistors TR6 and TR8 which together control TR7. The d.c. control voltage is developed across C23 and applied to the varactor diode D2 in the 34MHz Oscillator. R27 and C21 provide decoupling for the control voltage.

Logic Circuits

17. The logic circuits consist of 'nand' gates ML8, 'nor' gates ML9, ML10, and the inverting output buffers TR9-TR11. Inputs from the frequency selection switches on the front panel, routed via inverting circuits on the Noise Immunity Board, are applied to ML8 and ML9 at pins 13-17. The logic circuits produce control outputs at pins 19-21 which are fed to the HF Loop Board to select one of the three HF loop oscillators.

18. A logic '0' is required to be output from one (and only one) of pins 19-21 in order to select a particular oscillator; the remaining two pins must be at logic '1'. Table 1 shows the output at pins 19-21 for all combinations of inputs to pins 13-17.

TABLE 1 OSCILLATOR SELECTION LOGIC

INPUT PINS					OUTPUT PINS			OSCILLATOR SELECTED
16	15	17	13	14	21	19	20	
'1' on any pin			1	1	0	1	1	0-7MHz
0	0	0	1	1)				8-17MHz
or '1' on any pin			*	0)	1	0	1	
Any other condition					1	1	0	18-29MHz

'*' = immaterial

FREQUENCY SYNTHESIZER BOARD PM349 Fig.2 and Fig.5

19. This printed circuit board contains the circuits necessary to generate the 3.6 - 4.6MHz frequency (f2, described in Appendix 1); these comprise the following:

(a) 18-23MHz voltage-controlled oscillator (oscillator no.3).

(b) Programmed divider no. 3 ($\div$ n).

(c) Divide-by-2000 stage to produce the 500Hz reference frequency from the 1MHz standard frequency input.

(d) 500Hz phase comparator no. 3 and output circuit for the control voltage.

(e) Divide-by-5 stage to produce the 3.6 - 4.6MHz output from (a).

20. The board also contains logic circuits to produce an 'out-of-lock' signal when the oscillator is not phase-locked to reference frequency, and a filter and amplifier to produce a 1.4MHz output from the 1MHz standard frequency input.

18-23MHz Oscillator

21. Transistor TR2 and associated components form a variable-frequency LC oscillator, tunable over the range 18-23MHz by the bias voltage applied to varactor diode D1 in the oscillatory circuit. The output at frequency f0 is buffered by 'nand' gate G2 in ML1 and applied as the clock input to the divide-by-5 stage ML2. A square wave output from ML2 is buffered by G1 in ML1 before being applied to the step down transformer T1 via

the low pass filter L1, C1, C2. The 3.6 - 4.6MHz sinewave output f2 is taken from the secondary of T1 at pins 3 and 4 af the p.c.b. Transistor TR1 forms a series stabilizer for the oscillator circuit.

Programmed Divider No. 3

22. This consists of the presettable decade counters ML5, ML8, ML11, ML13 and ML16, 'and' gates G5 and G4 of ML6, 'nand' gates ML15 and the dual J-K flip-flop ML9.

23. The input to the divider at ML5 pin 8 is the autput f0 of the 18-23MHz oscillator, and the output af the divider at ML16 pin 2 is the frequency f0/n which is applied as the sample input to one half af the phase comparatar ML12. ML9 is also clocked by f0.

24. Gates ML6 and ML15 form a decoder, giving an output of logic '1' from ML8 pin 6 when a BCD count of 45997 is detected at the outputs af the counters.

25. The divider is programmable for any division ratio in the range 36001-46000 by the setting of the 'kHz' switches on the front panel; these apply the set figures (in BCD format) to the input lines of the first four counters.

26. The divider operates os follows. Assume an initial stote where all counters ore at 0, and where 4236 is set in BCD format on the input lines. When the clock input is applied to ML5 pin 8, the counters count up until the decoder gates detect a count of 45997.

27. At this point the J1 input of ML9a goes to logic '1', and three clock pulses later (at a count of 46000) the $\overline{Q1}$ output of ML9a goes to '0'.

28. This is applied as the strobe input to the counters, and strobes in the data on the input lines. The counters therefore reset to 4236, count up to 46000, and continue cycling in this manner, dividing by a figure of 46000-4236.

29. In general terms, the divider is programmable to divide by 46000-dddd, where dddd are the digits set on the 'kHz' switches.

Divide-by-2000 Stage

30. This stoge consists of the three binary decade counters ML3, ML4 and ML7 connected in cascade, followed by a single divide-by-two stage ML10. The input to the stage at pin 25 is a 1MHz squarewave (derived from the 5MHz frequency source) from the 34MHz Generator Board pin 12. The 500Hz output from ML10 (the reference frequency) is applied to one input of the phose comporator (ML12 and G6 of ML14).

Phase Comparator No. 3

31. This consists of the dual D-type flip-flop ML12, 'nand' gate G6 in ML14, and the voltage control circuit TR5-TR11 and ossociated components. The squarewove derived from the 18-23MHz oscillatar vio the programmed divider is applied as the clock

input to one half of ML12, and the reference 500Hz squarewave from the 5MHz frequency standard is applied as the clock input to the other half. Both D inputs are connected to +5V and held permanently at logic 1. The Q outputs of both halves are applied to the inputs of 'nand' gate G6 in ML14, and the output of G6 is connected to the 'clear' inputs of both halves of ML12 via the delay network R26, C25. The Q outputs are applied also to the bases of TR5 and TR7 in the voltage control circuit, and the $\overline{Q}$ outputs are fed to the out-of-lock indicator.

32. The operation of the phase comparator is as follows. If the inputs are in phase, i.e. if the oscillator frequency is 500 x n Hz, the Q1 and Q2 outputs go to '1' simultaneously; gate G1 therefore gives a '0' output which, applied to the 'clear' inputs of ML12, inverts both Q outputs to '0'. The Q1 and Q2 outputs thus both consist of a train of narrow positive pulses at a p.r.f. of 500Hz.

33. If the oscillator is lagging on the reference, the Q1 output is a train of narrow pulses and the Q2 output is a train of wide pulses. If the oscillator is leading, the Q1 output is a train of wide pulses and the Q2 output is a troin of narrow pulses.

34. These three conditions are illustrated by the idealized waveforms in Fig.4.2.

35. The voltage control circuit comprises transistors TR5 to TR12 and associated components - the control voltage being developed across capacitor C39.

36. If a wide pulse appears at the Q output of ML12a, this is converted by transistor TR7 into a current pulse, which will discharge capacitor C39 via transistor TR8, connected as a diode; similarly a wide pulse at the Q output of ML12b charges C39 via transistors TR5, TR6 and TR9. The voltage on C39 is fed via the source follower TR11 to the varactor D1 to complete the phase lock loop; R34 and C31 ensure the loop is stable. The effects of leakage in TR6, TR7 and the varactor D1 is eliminated by TR8, TR9 and TR11. Transistor TR10 is an o.c. stabilizer to prevent unwanted noise on the +20V d.c. line reaching the varactor line.

Lock Indicator

37. The $\overline{Q}$ outputs of the 500Hz phase comparator are applied to nand gates G9 and G10 in ML14; gate G11 on ML17 is connected as a buffer/inverter. The inputs to G10 are delayed by approximately 0.3μ secands by R38 and C31, R51 and C44 to ensure correct latching action.

38. In the in lock condition, a train of negative going pulses of approximately 50ns duration will be applied to G9 and G10 in ML14. These inputs will appear as logic '0' and logic '1' inputs to G9 (logic '0' during negative pulse) but, because of the delay caused by R35 and C30, R38 and C31, the negative going pulses will not appear at the input to G10; therefore in the in-lock condition, pins 4 and 5 of G10 will always be at logic '1'. Pin 6 of G10 will be at logic '0' which will be inverted by gate G11 in ML17 to produce a logic '1' in-lock indication on pin 24 of the p.c.b.

39. In the out-of-lock condition, one of the $\overline{Q}$ outputs from the phase comparator will consist of a train of wide negative going pulses whilst the other output will consist of a train of narrow negative going pulses (refer to para.33). Due to the delay caused by R35 and C30 or R38 and C31, the wide negative pulse will still be present at G10 after the input to G9 has returned to logic '1'; this will have the effect of resetting the latch in G9 and G10 producing a logic '1' output at pin 6 of G10. Gate G11 in ML17 will invert this logic '1' output from G10 to produce a logic '0' out-of-lock indication at pin 24 of the p.c.b.

40. The output of the out-of-lock indicator is fed off the board via r.f. filter L7 and C44 at pin 24.

Crystal Filter and Amplifier

41. A divided-by-5 output of 200kHz is taken from pin 9 to ML3 (the first component of the divide-by-2000 stage). This is passed via the 1.4MHz crystal filter (XL1 and XL2 to the tuned amplifier TR3 and TR4). The 1.4MHz sinewave output is fed off the board at pins 1 and 2.

HF LOOP AND TRANSFER LOOP BOARDS PS337 and PS338 Fig.7 and Fig.9

42. Although this area of the frequency generating circuit is contained on two printed circuit boards, it is convenient to describe them together rather than consider them seperately.

43. The principal function of these two boards is to generate f1 (36.4 - 65.4MHz) and f3 (885-947.8kHz) as described in Appendix 1. The actual frequency of f3 is determined by the setting of the thumbwheel frequency selector switch. f1 is phase locked to f3 via the programmed divider such that f1 = Nf3.

Generation of f3

44. The circuits generating f3 are contained on two boards as follows:-

(a) Voltage-controlled oscillator No.2 (D19, TR17, TR20 on the HF Loop Board, fig.7).

(b) Mixer No.1 and low-pass filter on the Transfer Board (fig.9) to produce the frequency 1MHz-f3.

(c) Programmed divider No.2 ($\div$ N) on the Transfer Board, producing an output $\frac{f2}{N}$ for use as the reference frequency.

(d) Phase comparator No. 2 on the Transfer Board, to lock the output of (a) at a frequency

$$1MHz-f3 = \frac{f2}{N}$$

Oscillator No.2 Fig.7

45. Transistor TR17, TR20 and associated components form a variable-frequency LC oscillator, tunable by the bias voltage applied to varactor diode D19 in the oscillatory circuit. The output at frequency f3 is applied as the clock input to the divide-by-two stage ML12. A sample of f3 is fed off the board at pin 13 via the buffer amplifier TR21 and applied to mixer No.1 on the Transfer Board.

Mixer No.1 and Low-pass Filter Fig.9

46. Mixer No.1 comprises the i.c. mixer module ML3, together with the input buffer amplifiers TR1, TR2, TR3.

47. The 1MHz stable signal is fed onto the board at pin 3 and applied to one input of ML3 via the buffer omplifier TR1, TR2. A sample of f3, generated by oscillator No.2, is applied to the other input of ML3 via pin 19 and buffer TR3, and the combined signal is fed vio the low-poss filter L11, L12 to the buffer amplifier TR6. The output frequency ot the collector of TR6 is 1MHz - f3, which is squared and inverted in 'nand' gate ML7o for opplication to the phase comparator.

Progrommed Divider No.2 ($\div$ N)

48. This consists of the presettable decade counters ML1, ML2, 'nand' gates ML4, ML5, and the D-type flip-flop ML6.

49. The input to the divider at pin 17 is the sinewave f2 generated by oscillator No.2, ond the output of the divider at ML6 pin 5 is the frequency $f2/N$, used as the reference frequency in the generation of f3.

50. The input signal is shoped by TR4, TR5, squared and inverted by 'nand' gate ML4a, ond applied as the clock input to the 'units' counter ML1.

51 Gates ML4b and ML5 form a decoder, giving an output of logic '0' when a count of 37 is detected at the outputs of the decade counters. The output at ML5 pin 8 is applied to the data input of ML6, which is clocked by the input frequency f2. The Q output of ML6 is opplied:

(a) To one clock input of the phase comparator ML8 as the reference frequency.

(b) To the decade counters ML1, ML2 as the strobing signal (logic '0' strobes in the data on the input lines).

52. The divider is programmable for any division ratio in the range 40-69 by the setting of the 'MHz' frequency selection switches on the front panel these apply the nines complement of the set figure (in BCD format) via the Noise Immunity Board to the data input lines of the divider (pins 8-15).

53. Table 2 shows the operation of the divider for various representative values of 'MHz' switch setting.

TABLE 2. OPERATION OF DIVIDER No.2

'MHz' setting	BCD input	Clock pulses				
		Count up (100-BCD i/p)	Commence strobe Pulse ML6	Fixed Caunt Detect	End strobe Pulse ML6	Total (= divisian ratio)
00	99	1	1	37	1	40
07	92	8	1	37	1	47
14	85	15	1	37	1	54
21	78	22	1	37	1	61
29	70	30	1	37	1	69

Phase Comporator No.2 Fig.9

54. This consists of the dual D-type flip-flop ML8, 'nand' gote ML7b, ond the voltage control circuit TR7-TR10. The squorewave 1MHz-f3 is applied as the clock input to one half of ML8, and the reference frequency $\frac{f2}{N}$ is applied as the clock input to the other half. Both D inputs ore connected to +5V and held permanently at logic 1. The Q outputs of both halves are applied to the inputs of 'nand' gate ML7b, and the output of ML7b is connected back in parallel to the 'clear' inputs of both halves of ML8. The Q outputs ore applied as control inputs to the valtoge control circuit.

Voltage Control Circuit Fig.9

55. The voltage control circuit camprises transistars TR7-TR10 and associated components; the d.c. contral valtage at TR10 callector is fed off the board at pin 4, and applied to varactor diode D2 in ascillatar No.2 via pin 18 on the HF Loop Board (fig.7).

Lack Indicator and Fast Lack Circuit Fig.9

56. This circuit comprises twa manostables, ML9, ML10, a dual D-type flip-flop, ML11, and NAND gates ML4c, ML4d. Its purpose is to augment the conduction of TR7 or TR10 in the out-of-lock canditian and so obtain a faster return to the locked canditian; it alsa pravides a lack indicatian output signal. The actian of the circuit is as follows.

57. The Q autput fram the phase comparatar flip-flop, ML8a is applied to the B input (Schmitt trigger) of the monostable, ML9, and also to the D and clear inputs of a D type flip-flop, ML11 Similarly, the Q output from ML8b is applied to the B input af the monastable, ML10, and also to the clear inputs of a second D-type flip-flop, ML11b.

The two monostables, triggered when positive going signals are applied to the respective B inputs, each produce a negative going output pulse ($\overline{Q}$), of approximately 1.5μs duration.

58. At the end of each output pulse the D inputs of ML11a and ML11b are sampled by their respective clock inputs to produce the appropriate in lock or out-of-lock $\overline{Q}$ outputs from the flip-flops.

59. In the in-lock condition, the Q outputs from the two flip-flops, ML11a, ML11b are both at logic '1'; these two signals do not however, affect the conduction of the voltage control transistors, TR7, TR10, due to the presence of the two diodes, D2, D3. The logic '0' output from ML4c is inverted by ML4d to produce a logic '1' in-lock signal of board pin 5.

60. If the output frequency from the mixer is low, the negative excursion of the $\overline{Q}$ output from ML11b will be applied to TR10, via diode D3. The conduction of TR10 will, therefore, be increased rapidly to bring about a fast return to the in-lock condition. The $\overline{Q}$ output from ML11b is also applied to ML4c to produce an alternating '01' out-of-lock signal at board pin 6.

61. Should the out-of-lock condition be due to a high mixer output frequency the $\overline{Q}$ output from ML11 will cause a rapid return to the in-lock condition by increasing the conduction of TR7; the Q output from ML11a is also applied to ML4c to produce an alternating '01' out-of-lock signal at board pin 6, as before.

Generation of f1 Fig.7

62. The circuits generating f1 are contained on the HF Loop Board and consist of the following main sub-units:-

(a) Voltage-controlled oscillator No.1, TR1-TR9, with a.g.c. stage TR10, TR13 and output buffer TR14.

(b) Programmed divider No.1 (÷ N), comprising ML3, ML5 and associated components.

(c) Phase comparator No.1, ML7, to lock the output of (a) at a frequency

$$\frac{f1}{2N} = \frac{f3}{2}$$

Oscillator No.1

63. The frequency range of the oscillator is 35.4 to 65.4MHz; this is provided by three switched oscillators each having the following frequency range:

Osc 1	35.4 to 42.4MHz
Osc 2	42.4 to 52.4MHz
Osc 3	52.4 to 65.4MHz

The oscillators are similar in construction and operation and the required frequenc band is selected by the setting of the 'MHz' switches on the front panel. These switches apply a control voltage of 0V to one of the pins 26, 27 or 28 via the logic circuits on the 34MHz Generator Board (Fig.3); this input turns on TR3, TR2 or TR1 supplying power to the associated oscillator.

64. Details of the three oscillators are as follows:-

	SELECTOR	OSCILLATOR	O/P BUFFER
Osc. 1	TR3	TR6, D8, D9, L6	TR9
Osc. 2	TR2	TR5, D6, D7, L5	TR8
Osc. 3	TR1	TR4, D4, D5, L4	TR7

65. The output of the selected oscillator is amplified in TR10 and applied to:

(a) The a.g.c. stage TR13, which controls the oscillator source potential (R38 sets the a.g.c. level).

(b) The squarer stage TR11, TR12.

(c) The output buffer amplifier TR14 (potentiometer R44 sets the stage goin); the output is fed off the board ot pin 20 as f1.

Programmed Divider No.1 ($\div$ N)

66. This consists of the presettoble decade counters ML3, ML5, J-K flip-flops ML2b, ML9, 'ond' gates ML4, and 'nand' gate ML6. ML3 is the 'units' counter and ML5 the 'tens' counter.

67. The input to the divider at ML3 pin 8 is the squarewave $f1/2$, derived from oscillotor No.1 vio the squarer stage TR11, TR12 and the divide-by-two pre-scaler ML2a; the output of the divider at ML2b pin 9 is the frequency $f1/2N$, which is fed to one input of the phase comporator ML7.

68. Gates ML4 and ML6a form a decoder, giving an output of logic '1' when a count of 35 is detected at the outputs of the decade counters. The output at ML4 pin 6 is applied to the J input of ML2b, which is clocked by the input frequency $f1/2$; both Q outputs of ML2b are fed to the dual J-K flip-flop ML9 (Q to J, $\overline{Q}$ to K), and the Q output of ML9b is fed back to the K input of ML2b. The effect of this circuit is to stretch the durotion of the '1' signal at the Q output of ML2b in order to enable the programmed divider to recognise the input data.

69. The $\overline{Q}$ output of ML2b is applied also to the decade counters ML3, ML5 as the strobing signol logic '0' strobes the data on the input lines.

70. The divider is programmable for any division ratio in the range 40–69 by the setting of the 'MHz' frequency selection switches on the front panel; these apply the nines complement of the set figure (in 8CD format) via the Noise Immunity Board to the data input lines of the divider.

71. Table 3 shows the operation of the divider for various representative values of 'MHz' switch setting.

TABLE 3. OPERATION OF DIVIDER No.1

'MHz' setting	BCD Input	Clock pulses				
		(100-BCD i/p)	Reset Counters ML2b	Fixed Count Detect	ML9o and ML9b	Total (÷ division ratio)
00	99	1	2	35	2	40
07	92	8	2	35	2	47
14	85	15	2	35	2	54
21	78	22	2	35	2	61
29	70	30	2	35	2	69

Note: The sequence of output is as follows:

1 start pulse in ML2b
1 counting pulse in ML9a
1 counting pulse in ML9b
1 finish pulse in ML2b

Phase Comparator No.1

72. This consists of the dual D-type flip-flop ML7, 'nand' gate ML6a and the voltage control circuit TR16-TR19. The squarewave $\frac{f1}{2N}$ from the programmed divider is applied as the clock input to one half of ML7, and the frequency $\frac{f3}{2}$ (derived from oscillator No.2 via the divide-by-two stage ML12) is applied as the reference frequency to the clock input of the other half. Both D inputs are connected to +5V and held permanently at logic 1. The Q outputs of both halves are applied to the inputs of 'nand' gate ML6a, and the output of ML6a is connected back in parallel to the 'clear' inputs of both halves of ML7. The $\overline{Q}$ outputs are applied as control inputs to the voltage control circuit.

Voltage Control Circuit

73. The voltage control circuit comprises transistor TR16-TR19 and associated components; the d.c. control voltage at TR19 collector is applied via R82 and RF chokes L21, L22, L23 to the varactor diode D4-D.

Out-of-lock Indicator

74. The Q outputs of the phase comparator are applied to the out-of-lock indicator comprising ML8, ML10, ML11 and associated components. This circuit operates in the same way as that described in paros.37 to 39.

LOW LEVEL BOARD PM341 Fig.11

Function

75. The Low Level board processes all the audio and key input signals to the exciter and produces a modulated output of 1.4MHz which is translated to the final output frequency by the mixer and output board. The board also contains the necessary attenuation circuits, and relay drivers for selection of the required sideband filters.

Keyed Mode

76. The MA.1720 generates a keyed output, by keying a 1kHz oscillator, which is then opplied to one of the bolanced modulators. When any of the key or CW positions are selected on the front panel, +12V is applied to the board via either pin 45 or 46, thus turning an TR9 and thence TR14, connecting +12V to the Tone Insertion Oscillator. +12V is also connected to TR1 via D18 and D12, turning on TR1 thus switching off the -7V regulator tronsistor TR3, muting chonnel 1 audio amplifier.

77. The keying input to the board is either direct keying on pins 44 and 43 or remote keying vio the RTTY board on pin 22. For direct keying, o closed key connects pins 44 and 43 and tokes TR15 base to 0V; for remote keying a +12V signal applied to the RTTY board applies approximately 20V to pin 22, turning TR8 on and taking TR15 base to 0V. TR15 collector rises towards +12V, producing the following results:

(o) It switches on TR18, connecting the output of the LC audio oscillator TR19 into the moin oudio path via R59, C29.

(b) It operotes the mute delay circuit TR20-TR26. In the 'normal' stote C40 is chorged to opproximately 6.5V and thus TR25 and TR26 are conducting, giving a 0V output to the 'OR' gate on the control board and muting the output. Upon initiation of keying, TR20 and TR22 are turned on, discharging C40 ropidly to 0V via R84; this turns TR25 and TR6 off, allowing the collector to rise to +12V which is applied to the control board to demute the exciter. Upon cessation of keying TR20 and TR22 are turned off, C40 chorges towards +12V via R83, ond when the potential on the base of TR25 reaches 6.5V, TR26 turns on taking pin 47 to 0V to mute the exciter. This ensures that so long as keying is not suspended for more than 2 seconds the exciter and any associated equipment remain active, but after this period of time they ore outomatically muted.

Tone Oscillator

78. The Tone Insertion Oscillator consists of a tuned transformer (1kHz) coupled oscillator; feedback is provided by R68 and R69 in the emitter circuit of TR19; R69 provides adjustment of the feedback level. Output level adjustment is provided by R65.

RTTY Mode

79. The RTTY signal from the RTTY Board pin 9 is fed onto the baard at pin 24 and rauted into the audio channel vio R114.

Audio Mode

80. The audio input is fed onto the board at pins 41 (audio 1) and 35 (audio 2), and is routed to pins 38 (32) via front panel level contral patentiameters; from there the Inputs are applied to similar AF amplifiers.

81. The audio 1 input at pin 38 drives the differential amplifier TR10, TR12 via the phase splitter TR6. The output at TR12 collector is applied to amplifier ML1, which has a gain af approximately 200 times; a.g.c. actian is provided by TR16 and diodes D13, D17. A sample of the audio output from ML1 is detected by D19, D23 and the resulting signal is used to control the current through TR16 and thus through D13 and D17; os the effective impedance of D13 and D17 is dependent upon the current flowing through them, this controls the overoll gain of the amplifier. As o potential of -3V is required on TR16 base to turn it on to set the output level from the amplifier ot approximately 4.5V peak-to-peak.

82. The output of ML1 is applied to the level control gates via the 'channel 1 gain' potentiometer R73. The level control gates are brought inta operation when reinserted carrier modes are selected in order to reduce the gain of the audio channel, thus preserving o constont p.e.p. level at the output.

83. The audio 2 input is similarly pracessed in the circuit comprising ML2 and associated components, and is applied to a 16dB level gate via potentiometer R75.

VOX

84. VOX aperatian is available on channel 1 on single sideband modes. A sample of the autput from ML1 is applied via the 'VOX sensitivity' potentiometer R79 to the amplifier TR23, TR24, the autput of which operates the Schmitt trigger TR27, TR29. The output of the Schmitt switches TR33 in the mute delay circuit TR33-TR39, which operates in the same fashion os the CW mute delay circuit, giving a fast attack, and a 2 second decay time.

Production af 1.4MHz First IF

85. The 1.4MHz [illegible]nal, [illegible]ed fr[illegible]e reference oscillator, is fed onto the board at pin 16 a[illegible]vel [illegible]ut 0 [illegible]n[illegible]plied. The a.g.c. amplifier TR43-TR46, which stabilises it at [illegible]el o[illegible] passed into a variable attenuator formed by [illegible] and T[illegible] TR43 and TR44.

The signal at the emitter of TR44 is amplified by TR45 and detected by D35 and D36; the resultant d.c. signal is amplified in TR46 and then applied to TR40, thus controlling the overall gain of the amplifier. The output level is adjustable by R149, and is set to be exactly 250mV r.m.s. at TP5. The low-impedance output from TR44 emitter is applied in parallel to:-

(a) The balanced modulator stoges TR41, D33, TR47 (channel 1) and TR42, D34, TR48 (chonnel 2).

(b) The 1.4MHz carrier insertion stage TR49-TR52.

B6. The output from channel 1 level gates is amplified in TR34, TR37, and the low-impedance output from TR37 emitter may be applied to either of the balanced modulators accarding to the state of RLA and RLB. The channel 2 madulating input at TR35 base is amplified in TR35, TR38; the low-impedonce output from TR38 emitter is applied to the channel 2 balanced modulator when the ISB mode is selected. The gain in channel 2 is set to the 6dB down on that of channel 1.

B7. The outputs of the balanced modulators are routed via band-pass filters to the input of the feedback summing amplifier TR55, TR57 where the 1.4MHz carrier frequency is re-inserted (vio the amplifier and switch TR51) to form the first IF of 1.4MHz; this is fed off the board ot pin 10 at o level of 0dBm. D45, D46, D47 form a limiter circuit orranged to operate when the level on TP6 is about 9V peak-to-peak (output level of +2dBm) to prevent overloading of following stoges.

Attenuotion Circuits

88. Attenuation gates ore provided as follows, energised by +12V d.c. inputs to pins 26 (6dB), 23 (16dB) and 20 (26dB or 20dB - see note).

(o) 6dB gates

(i) TR28, shunting the chonnel 1 modulating input to TR34 (ottenuates signal by 6dB).

(ii) TR54, shunting the 1.4MHz output from TR51.

(b) 16dB gates

(i) TR32, shunting the channel 1 modulating input to TR34 (ottenuates signal by 1.5dB).

(ii) TR30, shunting the channel 2 modulating input to TR35.

(iii) TR60, shunting the 1.4MHz output from TR51.

(c) 26dB gate (or 20dB - see note)

TR53, shunting the 1.4MHz output from TR51.

NOTE: For 20dB attenuation, R188 is changed from 18 ohms to 39 ohms.

89. The 'Tune' attenuator TR61 is energised by +12V d.c. at pin 27, and shunts the 1.4MHz output from TR51. Its attenuation may be adjusted by means of R204.

90. When any of the above attenuation gates are selected, +12V is applied to the base of TR49 via the appropriate diode in the chain D37–D41 and the base resistor R166. TR49 will switch on, switching off TR50 which will switch on TR52. This action will switch on the 1.4MHz amplifier TR51, and the 1.4MHz signal will be applied via the amplifier to the appropriate attenuator gate. The gain of this stage is controlled by R184.

Relay Drivers

91. Relays RLA and RLB are driven by TR21 and TR31 respectively; their contacts control the routing of the modulating inputs to the balanced modulators.

92. When 'LSB' is selected by applying +12V to pin 30, RLA in TR21 collector is energised and contact RLA1 routes the channel 1 input to the channel 2 modulator, the output of which is taken to the USB filter.

93. When 'USB' is selected, both relays are de-energised and the channel 1 input is routed via the channel 1 modulator to the LSB filter.

94. When 'ISB' is selected, RLB is energised via TR31; RLA is de-energised, and the channel 1 input therefore generates the upper sideband while the channel 2 input generates the lower sideband.

Auxiliary Control Inputs

95. The auxiliary control functions are summarised in Table 4.

TABLE 4. CONTROL FUNCTIONS ON LOW LEVEL BOARD

CONTROL INPUT	OPERATION ON APPLICATION OF +12V
Full Power (pin 9)	Sets the output to maximum by switching on TR58 and setting the gain af the output amplifier to maximum.
Low Power (pin B)	Switches on TR56 allowing output level to be adjusted by R190 - this enables the output level to be set between 0dB and -7dB down on the normal level.
-6dB (pin 26)	Turns on 1.4MHz switch (TR51) via D39, operates 1.4MHz 6dB gate (TR54), and 6dB audio gate (TR28).
-16dB (pin 23)	Turns on 1.4MHz switch (TR51) via D37, operates 1.4MHz 16dB gate (TR60), and 16dB audio gates (TR30, TR32).
-26dB (or -20dB) * (pin 20)	Turns on 1.4MHz switch (TR51) via D40, operates 1.4MHz 26dB or 20dB gate (TR53)*
IS8 (pin 29)	Operates RLB (TR31) and 6dB audio gate via D26
Tune (pin 27)	Mutes audio by turning off -7V regulator (TR3) via D28. Turns on 1.4MHz switch (TR51) via D41, operates tune gate (TR61) allowing tune level to be set by R204. Also operates full power gate (TR58) via D51, and inhibits low power gote.
LSB (pin 30)	Operates RLA (TR21)
RTTY ON (pin 21)	Mutes audio by turning off -7V regulator (TR3) via D9, D12.
CW-6 (pin 45)	Switches on the tone insertion oscillator by turning on TR14 via D4 ond D10. Operates 6dB audio gate (TR28) via D1, D2, D27, and 1.4MHz switch (TR51) vio D1, D2 and D39, and 1.4MHz 6dB gate (TR54) via D1, D2. Also mutes audio by turning off -7V regulator (TR3) vio D4, D1B and D12.
CW supp. (pin 46)	Switches on the tone insertion oscillator by turning on TR14 via D3 and D10. Mutes audio by turning off -7V regulator (TR3) via D3, D1B and D12.

* Resistor R1BB is changed to 39 ohms for 20dB.

Meter Amplifier

96. Transistors TR62-TR64 form a meter drive circuit. The amplifier accepts audio inputs at approximately -30dBm at pin 15, and with diodes D48, D49 in the feedback network provides 100μA d.c. for full scale deflection of the front panel meter. R195 is for initial calibration of the meter circuit.

TABLE 5. POTENTIOMETER SETTINGS, LOW LEVEL BOARD

POTENTIOMETER	SETTING
Audio Gain 1 (R73)	Should be set so that at the top end of the AGC range (+20dB above onset of AGC control) level on pin 2 is 420mV r.m.s.
Audio Gain 2 (R75)	Should be set so that at the top end of the AGC range (+20dB above onset of AGC control) level on pin 3 is 210mV r.m.s.
VOX (R79)	With audio set to minimum end of AGC range increase R79 until VOX circuit operates.
SET METER (R195)	When a 0dBm signal is input to the exciter and the meter switch is set to measure the line, the potentiometer should be set so that the needle points to the 0dBm mark.
CW limiting	Adjust such that the sine wave on TP1 is limiting on one peak and back-off approximately 0.5V.
Set CW (R65)	Set front panel switch to CW, and operate a key plugged in the front panel. Adjust for 420mV r.m.s. on pin 2.
Set 1.4MHz level (R149)	Set level on TP5 to 224mV r.m.s. with a 0dBm ± 3dB signal input at 1.4MHz on pin 16.
Set carrier (R184)	Set front panel switches to high power and to AM-6. Remove all audio inputs and adjust until level on pin 10 is -6dB into 50 ohm.
Tune (R204)	As required.
Low Power (R190)	As required.

RTTY GENERATOR BOARD PM340

Fig. 13

Function

97. The RTTY Generator accepts the Remote keying (+12V d.c. mark, and open circuit for space) for the RTTY keying inputs (5-0-5V d.c. or 80-0-80V d.c.) and produces the mark/space output voltages on the Remote keying mode or the mark/space audio frequencies in the RTTY mode. The mark/space frequencies may vary from ±75Hz to ±425Hz about a 2kHz nominal frequency. The Remote keying and RTTY outputs are bath applied to the Low Level Board. The Remote keying output is taken from pin 2 of the p.c.b. whilst the RTTY output is taken from pin 9.

NOTE: An additional board (PS567) provides the abave inputs to the RTTY Generator when Polar or Neutrol Keying is required. Refer to Appendix 2 for detoils of this option.

Remote Keying

98. The keying input ot pin 3 is applied via the voltage divider network R1, R2 to the gate of TR1; the voltage appearing at TR1 gote is limited between +4V ond -5.4V by zener diodes D1 and D2. TR1 switches the base of TR2, producing on output from pin 2 of approximately +20V mark and 0V space.

RTTY Mode

99. The input which may be derived from a 5-0-5V or an 80-0-80V supply is applied via pin 3 to TR1 gate and switches TR2. The output moy be taken directly from TR2 collector or via the inverting stage TR3 according to the position of link LK1 (which provides 'normol' keying in position A-B and 'reverse' keying in position A-C) and is applied via R12 to the coupled emitters of TR4 ond TR5.

100. TR4, TR5, TR6, TR7 and C3 shape the input to trapezoidal form (constant-current sources being provided by TR6 ond TR7) with rise ond fall times of approximately 750μs and amplitude of +20V p-p; this output is then opplied via R15 and TR8 to TR9, to control the parameters of the pulse generator TR11, C4, C5. R22 in TR9 emitter controls the generator frequency ond is set to give a p.r.f. of 4kHz; R15 in TR8 base controls the frequency shift within the range ±70Hz to ±425Hz. The output of the pulse generotor is coupled by C8 into the 'clock' input of the J-K flip-flop ML1, which produces o squorewove output at half the input frequency. This is fed off the board at pin 9, via the level-control potentiometer R31, to pin 24 on the Low Level Board.

101. TR10 ond associated com[illegible]ts fo[illegible]he enable/inhibit stage for the RTTY output. When +12V is opplied a[illegible]7 [illegible]1/31 [illegible] the front panel zener diode D11 conducts and turns TR10 on, appl[illegible]lo ic[illegible] the [illegible]put of [illegible]L1 and [illegible]nobling the output; an open circ[illegible]t at pin X app[illegible]s [illegible] [illegible]irp[illegible]d inhi[illegible] the [illegible]. The output moy als[illegible]bled by +12V ppl[illegible]n[illegible]3 [illegible]ront[illegible]l vi[illegible]e 'TTY TEST' pin 5 dn[illegible]D10; this [illegible] sele[illegible]a mar[illegible]ply[illegible] posi[illegible]i[illegible] to TR1 via R3, 6v[illegible]y input [illegible]3.

Pulse Generator/Tone Oscillator

102. The pulse generator uses a complementary unijunction transistor TR11. At the beginning of a cycle, C4 charges via TR9 towards 0V; when the B1-E voltage on TR11 reaches a value of approximately 8.6V, C4 discharges via TR11 and R21, causing a voltage pulse of approximately 5V peak to be developed across R21.

103. The frequency of oscillation is controlled by the current through TR9, which is adjustable by R22, and also by the potential at TR8 base which is determined by the setting of R15 and the switching waveform from the trapezoidal shaper.

MIXER & OUTPUT BOARD PM342 Fig.15

104. This board contains the following circuits:-

(a) First and second mixer circuits, with associated filters and amplifiers.

(b) Input amplifiers for the 34MHz fixed and 35.4-65.4MHz variable frequencies.

(c) Muting circuit.

Mixers & Output Amplifier

105. The 1.4MHz first i.f. from the low level board is fed onto the mixer and output board at pin 4 at a level of 0dBm and into the first mixer stage T1, T2; there it is mixed with the 34MHz stable frequency from the 34MHz Generator Board to produce the second i.f. of 35.4MHz. Unwanted frequency components are removed by the bandpass L-C filter including C7-C30, which provides 50dB attenuation of the fundamental and 70dB image rejection.

106. The signal is then amplified by TR7, TR8, filtered again in the crystal filter, (which reduces wideband noise into the final mixer and has a pass-band of ±6kHz centred on 35.4MHz), and then fed into the final mixer T8, T10. There it is mixed with a signal in the range 35.4-65.4MHz derived from the synthesizer boards, and the resulting signals are filtered by the low-pass filter L8-L10 (which has a sharp cut-off above 30MHz). The output from the filter is a signal in the range 1-30MHz at a level of -16dBm; this is applied via the buffer amplifier TR14, TR15, which also incorporates a gain control R67, to the input of the five-stage wide-band output amplifier TR9-TR13. The output at a level of +23dBm is taken off the board at pin 16.

Input Amplifiers

107. The two input amplifiers, for the 34MHz fixed frequency and the 35.4-65.4MHz variable frequency, are similar in construction and operation.

108. The 34MHz signal is fed onto the board via pin 3 at a level of 0dBm and a.c. coupled into the base of the drive [illegible] TR1. The output of the push-pull stage TR2, TR3, is a 20V p-p sinewave to the first

109. The 35.4 - 65.4MHz signal is fed onta the board via pin 8 at a level of 0dBm, and a.c. caupled into the bose af driver transistar TR4. The output of the push-pull stage TR5, TR6, is a 20V p-p sinewave to the secand mixer.

Muting Circuit

110. The muting circuit TR16, TR17 contrals the HT supply ta the callectors af TR9-TR12 in the autput amplifier. Transistor TR17 is normally held an by the +12V d.c. input to pin 12 from pin 5 on the Cantrol Board and TR16 is bottamed, applying +20V ta the autput amplifier. When TR17 base is taken down to 0V, TR16 cuts off and remaves the supply ta the amplifier.

NOISE IMMUNITY BOARD PM346 Fig.17

111. The function af the naise immunity board is to prevent random operation af any of the 24 frequency selection lines by noise or RF signals picked up on the lines when the unit is used on extended contral.

112. The baard contains 24 circuits (ane for each frequency selection line) which accept +12V far 'select' and open circuit for 'not select'. The input line to each circuit is taken via a 4.7k ohm resistar to the -7V rail (earth clamp diodes in the tronsistor base circuits prevent reverse base/emitter valtoge breakdown) and thus a voltage greater than approximately 8V (relative ta -7V) must be opplied to the input line before the transistor will conduct.

113. The autputs of the board ore taken from the collectors of tronsistors to the inputs of the three progrommed dividers; selection of o line couses the ossocioted transistor ta conduct and opply lagic '0' ta the divider input.

CONTROL BOARD PM345 Fig.19

114. The Contral Board lagic and switching circuits accept the inputs and produce the outputs summarised in Table 7.

TABLE 7. CONTROL BOARD INPUTS AND OUTPUTS

INPUT/PIN		OUTPUT/PIN	
Reset (+12V)	29	'Reset' to Tx (+12V)	30
		Removes earth from 'Reset' lamp	4
		Removes +12V from remate 'Reset' line	32
In lock (+5V)	25,26,27	Earth to 'In lock' lamp.	3
		+12V ta remote 'In lock' line	31
Mute (+12V)	24	'Mute' to Mixer & Output Board (+12V)	5

TABLE 7 (Contd.)

INPUT/PIN		OUTPUT/PIN	
Selector Switch inputs (+12V)	18,19,20,21	'De-mute' to Mixer & Output Board and Tx (+12V)	5
Tune Switch (+12V)	17	'Tune' to Low Level Board (+12V) 'Inhibit' to Mode Switch (0V) 'De-mute' to Mixer & Output Board and Tx (+12V)	11 12 5
Fault (0V)	1	Earth to 'Reset' lamp. +12V to remote 'Reset' line 'Mute' to Mixer & Output Board and Tx (0V)	4 32 5
Reduced Power (+12V)	6	Earth to 'Reduced Power' lamp. +12V to remote 'Reduced Power' line	7 33
Ready (0V)	8	Earth to 'Ready' lamp. +12V to remote 'Ready' line. 'Enable' to Mode Switch (+12V)	10 34 12
Standby (+12V)	13	Earth to 'Standby' line	14
EHT On (+12V)	15	Earth to 'EHT On' line	16
Power Supplies			
+12V	9		
+5V	2		
-7V	28		
Earth	22		
Logic Earth	23		

'Reset' Input (pin 29)

115. Pin 29 is normally open circuit. When the 'Reset' button on the front panel is pressed, +12V is applied to pin 29; this turns TR2 on, with the following effects:

(a) TR1 turns off, applying +12V to the linear amplifier as a 'Reset' command via pin 30.

(b) The '0' at TR2 collector is inverted by G1 and used to trigger the 2-second monostable ML4, which applies '0' for 2 seconds to G2 and G3; this resets the latch described in paras. 127 to 129.

'In lock' Input (pins 25, 26, 27)

116. The inputs to these pins are derived from the lock indicators associated with each of the three phase comparators in the frequency synthesizer, which output '1' to indicat the 'in lock' condition. When all three inputs are at '1', the output of G6 is '0'; this is inverted ta '1' by G8 and applied to:

(a) TR4, which turns on and lights the 'in lock' lamp via pin 3, and also turns TR5 on to apply +12V to the remote 'in lack' line via pin 31.

(b) G4 in the latch circuit, leaving the latch in the 'normal' (de-muted) condition.

'Mute' Input (pin 24)

117. Pin 24 is normally open circuit. When the 'Mute' switch is operated, +12V is applied via pin 24 to TR8, turning it on and applying '0' to one af the inputs of G9; G9 therefore outputs a '1'. This turns TR9 on and applies a 'mute' command of 0V via pin 5 to the tronsmitter and to the mixer ond output board.

Selector Switch Inputs (pins 17-21)

118. A +12V signal on any of these inputs, applied through TR12 and G10, results in a '1' being input to G9. If there is no +12V signal present at any of these inputs a '0' is opplied to G9, which results in a 0V 'mute' commond being output from pin 5 via TR9.

119. A +12V signal from the 'Tune' switch on pin 17, in addition to the above actions, applies o +12V 'tune' signal to the Low Level Board via D17 and pin 11; it also switches TR17 on via zener diode D18, removing the +12V supply to the mode switch via TR16 and pin 12 to prevent selection of other modes.

'Fault' Input (pin 1)

120. In normal operation, +12V is opplied to pin 1; this back-bioses D1, causing zener diode D2 to conduct ond turn TR3 on, thus opplying logic '0' to G2. A fault condition is signolled by 0V at pin 1, resulting in a '1' input to G2 and a '0' output. This causes the output of G5 to go to '1', lighting the 'reset' lamp via TR6 and pin 4 and applying +12V to the remote 'reset' line via TR7 ond pin 32. The '1' output from G5 is also applied vio G7 and G9 to TR9, producing o 0V 'mute' output at pin 5.

121. If the 'Reset' button is now pushed, the output of G5 will change to '0' only for the 2-second period of the monostable ML4; the drive unit will therefore de-mute, ond the 'reset' light will go out, for only two seconds.

'Reduced Power' Input (pin 6)

122. Pin 6 is normally held at 0V. [illegible] linear amplifier is operating at reduced power +12V is [illegible]ed, turn[illegible] [illegible]R11 o[illegible] TR10 lights the [illegible] 'power' lamp via pin [illegible] nd TR[illegible] ies +1[illegible] 'redu[illegible]ed p[illegible]wer' line wi[illegible]

'Ready' Input (pin 8)

123. Pin 8 is held at +12V when the linear amplifier is 'not ready'. When it is 'ready' the input goes to 0V, turning TR13 off, TR14 on and TR15 on. TR14 lights the 'ready' lamp via pin 10, and TR15 applies +12V to the remote 'ready' line via pin 34; TR14 also removes the drive from TR17 via D15 and D18, turning TR16 on and applying +12V via pin 1 to enable the 'Mode' switch.

124. In the absence of a 'ready' input (i.e. if pin 8 is at +12V) TR14 collector is at +12V; this is applied to:

(a) The 'tune' control line on the Low Level Board via D15 and pin 11.

(b) TR12 via zener diode D13, D14 and R34, turning TR12 on and applying logic '1' via G10 to pins 1 and 2 of G9.

'Standby' Input (pin 13)

125. A +12V signal is applied to pin 13 when the front panel 'Standby On' button is pushed; this turns TR18 on and applies a 0V signal to the linear amplifier via pin 14. When 'Standby' is not selected, pin 13 is open circuit and the output at pin 14 is +12V.

'EHT On' Input (pin 15)

126. A +12V signal is applied to pin 15 when the front panel 'EHT On' button is pushed; this turns TR19 on and applies a 0V signal to the linear amplifier via pin 16. When 'EHT On' is not selected, pin 15 is open circuit and the output at pin 16 is +12V.

Latch Circuit G3/G4

127. Gates G3 and G4 form a latch, which is reset by a '0' on pin 4 of G3 and tripped by a '0' on pin 9 of G4. When the synthesizer is caused to go out of lock by a change in the frequency setting, a fast negative pulse is applied to pin 9 of G4 (see para. 116). This trips the latch, causing a '0' to appear on pin 6 of G3 and a '1' on pin 11 of G5; this turns TR6 on, lighting the 'Reset' lamp via pin 4 and applying +12V to the remote 'Reset' line via TR7 and pin 32.

128. The '1' on pin 11 of G5 is inverted by G7 and applied to pin 5 of G9, causing G9 to output a '1'; this turns TR9 on, placing a 0V 'Mute' signal on pin 5. D5 in TR9 collector protects TR9 against reverse switching pulses from the relay connected to the 'Mute' line.

129. The latch G3/G4 is reset by a '0' on pin 4 of G3, applied via pin 29, TR2, G1 and the monostable ML4 when the 'Reset' button is pushed.

POWER SUPPLY BOARD PM343 — Fig. 21

General Description

130. The power supply board, in conjunction with external transistors and resistors, stabilizes the unregulated potentials from the transformer and rectifiers.

131. The supply is fitted with turnover current limiting an all the supply rails to prevent damage should a short circuit occur.

Electrical Characteristics

Inputs:
- Positive 36V ± 4V unregulated-smoothed
- Pasitive 22V ± 2V unregulated-smoathed
- Positive 11.5V ± 2V unregulated-smoathed
- Floating 16V ± 2V unregulated-unsmaathed

Outputs:
- Positive 20V ± 2V variable
- Maximum current 1.5A
- Positive 5V ± 0.5V variable
- Maximum current 1.5A
- Negative 7V ± 0.5V variable
- Maximum current 0.5A
- Positive 12V ± 2V
- Maximum current 1.5A

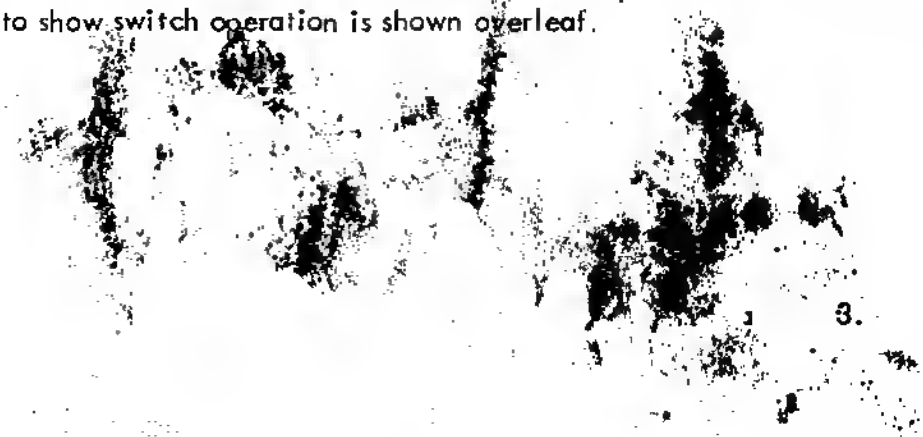
FREQUENCY SELECTOR SWITCHES — Fig. 28

General Description

132. The Frequency Selector Switch consists of six individual switches; there is one switch for each frequency decade.

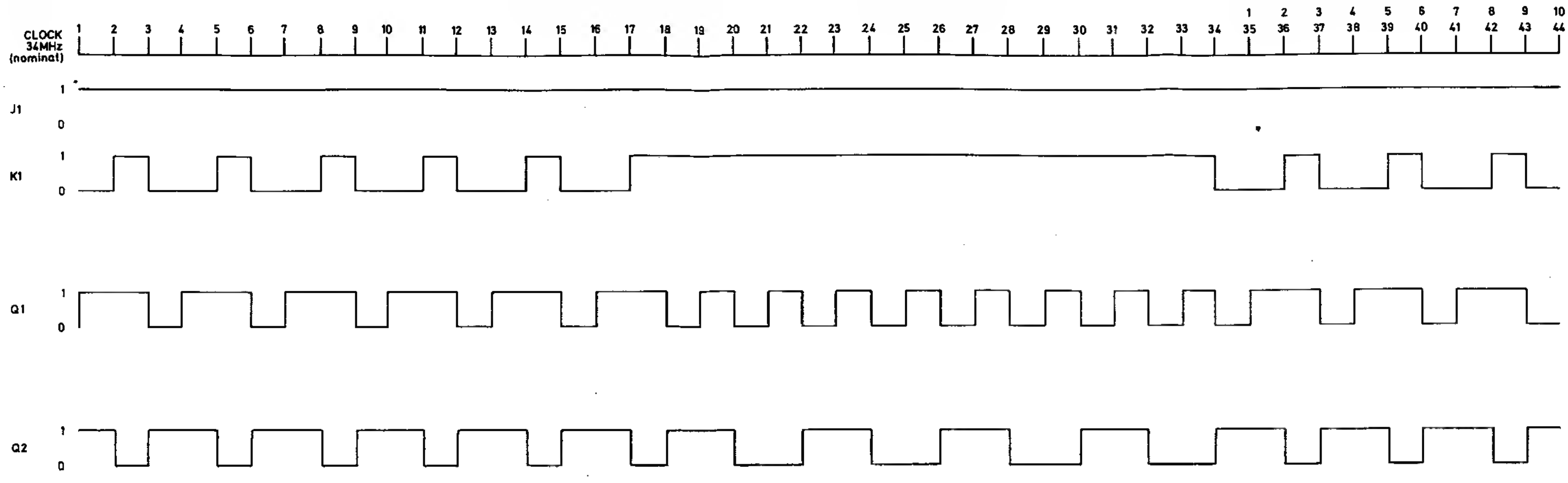
133. Each switch accepts +12V, and according to the value the switch is set at, routes +12V or an open circuit to the switch output. Figure 4-3 shows all the passible positions of the four switch sections for each of the six switches.

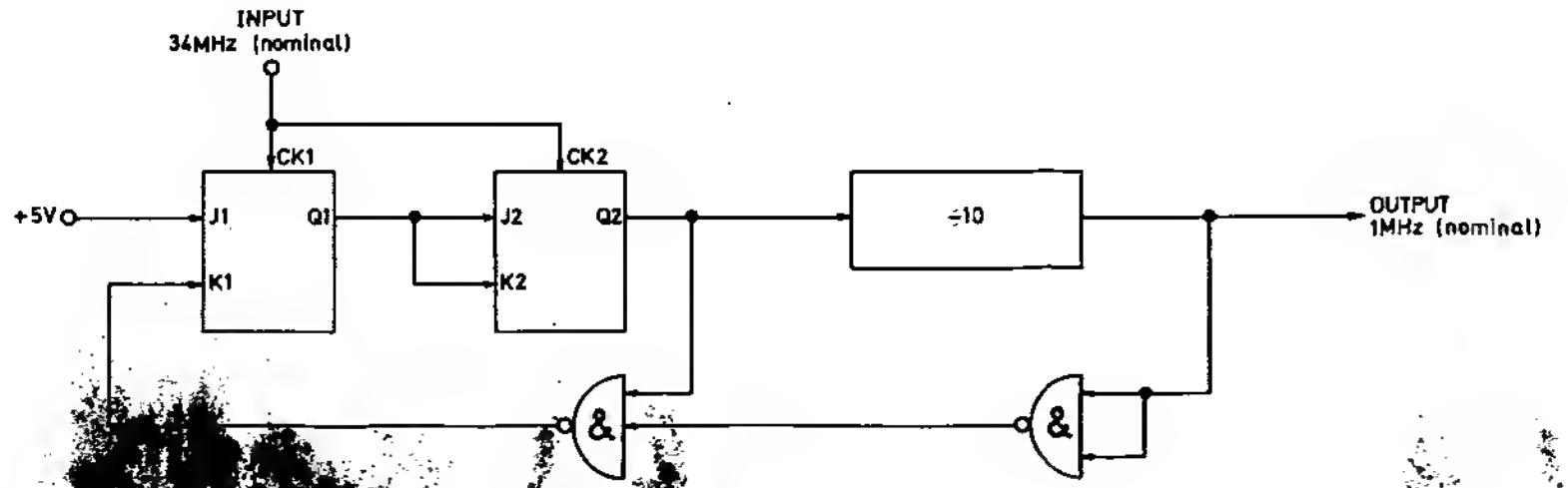
134. The state of any frequency selection line is either open circuit or +12V. The MHz x 10 and MHz x 1 switches provide an inverted and 9's complement BCD output; the kHz x 100, kHz x 10, kHz x 1, and Hz x 100 switches provide an inverted BCD output. A truth table to show switch operation is shown overleaf.



Note: 1 = +12V, 0 = open circuit

		Switch Setting (Decimal)									
		0	1	2	3	4	5	6	7	8	9
Binary	2^0	0	1	0	1	0	1	0	1	0	1
	2^1	0	0	1	1	0	0	1	1	0	0
	2^2	0	0	0	0	1	1	1	1	0	0
	2^3	0	0	0	0	0	0	0	0	1	1
Inverted Binary (100Hz, 1kHz, 10kHz, & 100kHz decades)	2^0	1	0	1	0	1	0	1	0	1	0
	2^1	1	1	0	0	1	1	0	0	1	1
	2^2	1	1	1	1	0	0	0	0	1	1
	2^3	1	1	1	1	1	1	1	1	0	0
9's complement of switch setting (Decimal)		9	8	7	6	5	4	3	2	1	0
Inverted 9's Complement Binary (1MHz & 10MHz decades)	2^0	0	1	0	1	0	1	0	1	0	1
	2^1	1	1	0	0	1	1	0	0	1	1
	2^2	1	1	0	0	0	0	1	1	1	1
	2^3	0	0	1	1	1	1	1	1	1	1

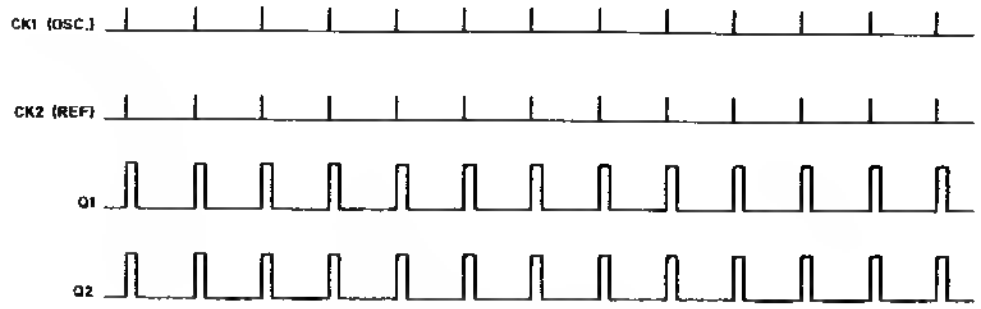




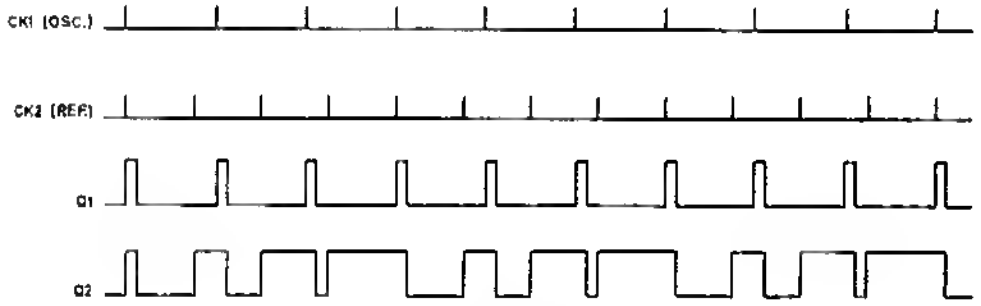
J–K Truth Table		
tn		tn+1
J	K	Q
0	0	Qn
0	1	0
1	0	1
1	1	$\overline{Qn}$

WOH2085

Waveform Diagram: Divide-by-3 [illegible] Fig.



OSCILLATOR AND REFERENCE IN PHASE



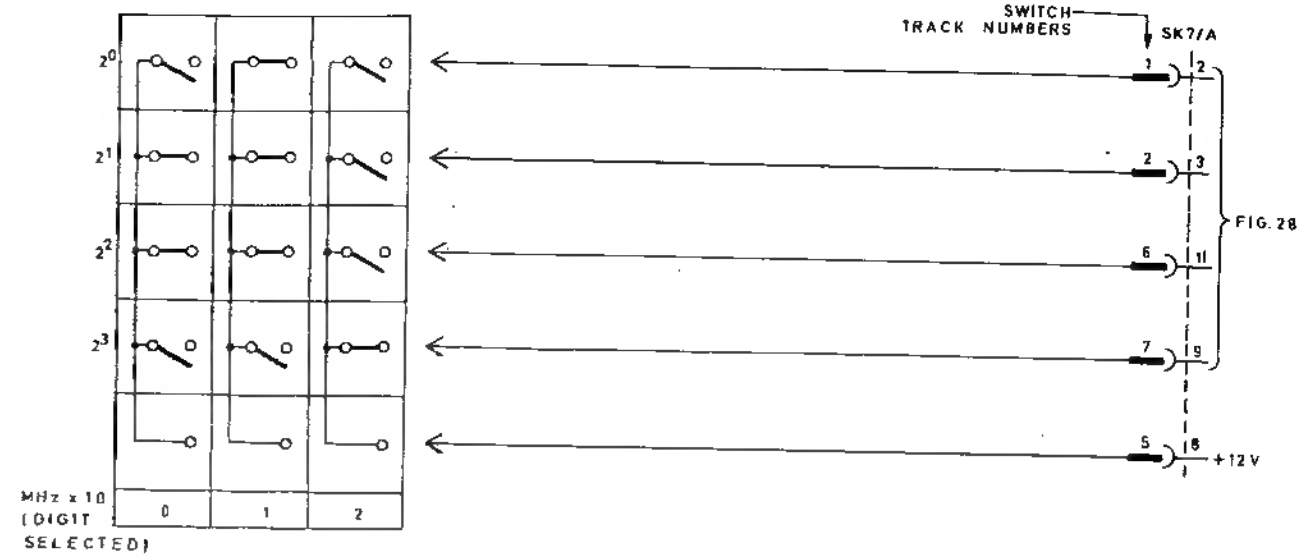
OSCILLATOR LAGGING (FREQUENCY LOW)

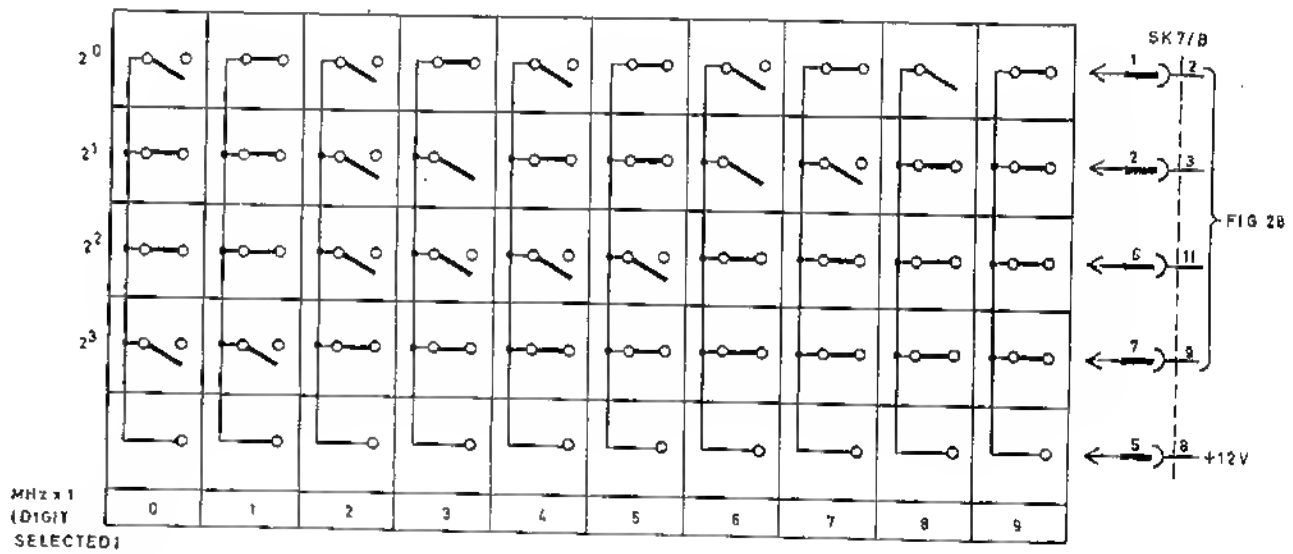
OSCILLATOR LEADING (FREQUENCY HIGH)

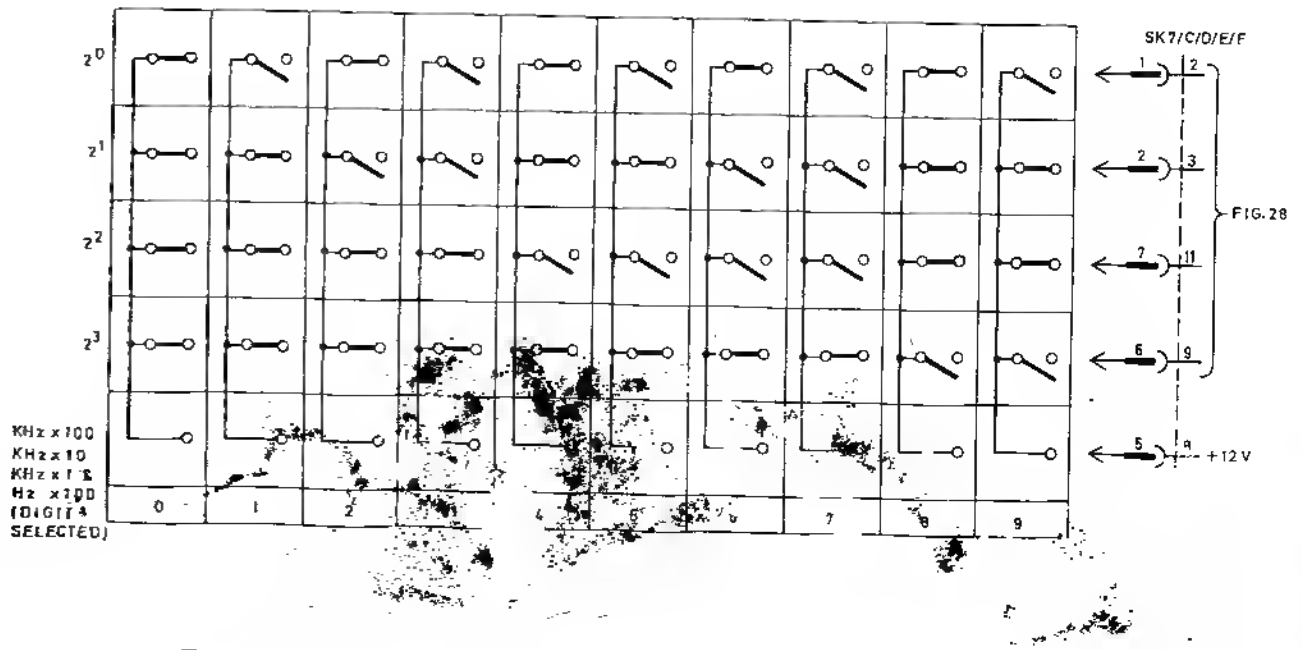
WOH2

Phase Comparc -Id ed

Fig.4.2







WDH 2085

Frequency Se or No.3 - W Di

Fig.4.3

CHAPTER 5

MAINTENANCE AND FAULT LOCATION

INTRODUCTION

1. A list of test equipment required for maintenance and fault locotion is given below. The procedures should preferobly be carried out at room temperoture (+20°C).

Test Equipment

(1) Pawer Supply

Stobilised Pawer Supply

Outputs	+5V at 1A +12V at 1A

Stobilised Pawer Supply

Outputs	+20V ot 1A -7V at 1A

Exomple: Advonce Type PP3

(2) Audio Signol Generotor (Two Tone)

Example: Marconi Type 2005R

(3) Multimeter

20,000 ohms per volt

Example AVO 8 or 9

(4) Digitol Frequency Meter

Frequency Ronge: 900kHz to 70MHz

Example: Racal Type 9022

(5) Electronic Voltmeter

Voltoge Range: 100mV to 30V

Example: Airmec Type 301A or Farnell Type TM6 with Probe to Type N Adaptor, 50 ohm Terminated (Type TM6/4).

(6) Oscilloscope

Dual Beam Oscilloscope with delayed time base facility.
Bandwidth: 65MHz or better.
Sensitivity: 100mV/cm with high impedance probe.

Example: Tektronix 454

(7) Spectrum Analyser

0 - 100MHz

Example: Hewlett Packard
141T Display Section
8552 IF Section
8553 RF Section

MAINTENANCE

Note: When operating the MA.1720 as an independent unit it is necessary to terminate the output with a 50 ohm load and to link pin 9 to pin 3 on socket SK6.

Setting-up Power Supply Board PM343

2. Use the multimeter to measure the supplies at TB2; adjustment of a supply is by the associated potentiometer on the Power Supply Board.

TB2	Supply	Adjustment
1 + 2	-7V + 0.25V	R12
3 + 4	+5V ± 0.25V	R9
5 + 6	+12V ± 0.5V	R33
7 + 8	+20V ± 0.5V	R22

Frequency Synthesizer Board PM349

3. Set the front panel frequency selector switches to 000000MHz and adjust L2 on the Frequency Synthesizer Board PM349 to obtain a reading of +15V d.c. at TP5.

4. Set the front panel frequency selector switches to 29.9999MHz and check that the voltage at TP5 is now 3.5V d.c.

HF Loop Board PS337

5. Connect the oscilloscope to TP4 and adjust R38 to obtain a reading of 3V p-p.

6. Use the electronic voltmeter to measure the level at pin 22 of the p.c.b. and adjust R44 to obtain a reading of 225mV (0dBm into 50 ohms).

7. Set the front panel frequency selector switches to 29.9999MHz and adjust L20 to obtain a reading of +8V d.c. at pin 18 of the p.c.b.

8. Set the front panel frequency selector switches to 6.9999MHz and adjust L4 to obtain a reading of +14V d.c. at the collector of TR19.

9. Set the front panel frequency selector switches to 17.9999MHz and adjust L5 to obtain a reading of +14V d.c. at the collector of TR19.

10. Set the front panel frequency selector switches to 29.9999MHz and adjust L6 to obtain a reading of +14V d.c. at the collector of TR19.

Setting-up Mode Levels

11. (1) Set the MODE SELECTOR switch to AM-6 and use the Electronic Voltmeter to monitar the output at SK4 on the rear panel. Adjust transformer T6 on the Low Level Board for maximum output.

(2) Adjust inductors L2, L3, L4, L6 and L7 on the Mixer and Output Board for maximum output and adjust R70 on the Mixer and Output Board for an output voltage of 1.6V r.m.s. (-6dB on dB scale of Electronic Voltmeter).

(3) Set the front panel meter switch to RF ond adjust R64 on Mixer and Output Board to obtain a reading of -6dB on the front panel meter.

(4) Set MODE SELECTOR switch to SSB-16 and check that the output level falls by 10dB ± 1dB to that obtained in (3).

(5) Set the MODE SELECTOR switch to SSB-26 and check that the output level falls by 20dB ± 1dB to thot obtained in (3).

(6) Switch the MODE SELECTOR switch to SSB SUPP ond use the Audio Signal Generator to insert a signal of 0dBm into 600 ohm at o frequency of 1kHz into LINE 1 socket on the front ponel. Turn the SET LINE potentiometer on the front panel fully anti-clockwise.

(7) Set the METER switch to LINE 1 and adjust R195 on the Low Level Board to obtain a reading of 0dBm on the front panel meter.

(8) Decrease the output of the Audio Signol Generator by 20dB ond ensure that the front panel meter reading falls by 10dB ± 0.5dB. Increase the output of the Audio Signal Generator ta 0dB.

(9) Set the METER switch ta SET 1, and adjust the SET LINE 1 potentiometer to obtain.o reading of 0dB on the front panel meter (with an audio input).

(10) Set the METER switch to RF and increase the output of the Audio Signal Generator by 10dB. Adjust R73 on the Low Level Board to obtain a reading of 200mW on the front panel meter.

(11) Alternate the setting af the SIDEBAND SELECTOR switch between UPPER and LOWER and adjust in turn potentiometers R175 and R176 on the Low Level Board to obtain equal output levels of 200mW for each sideband.

(12) Decrease the output of the Audio Signal Generator by 20dB and check that the output level does nat fall by more than 1.5dB.

(13) Set the VOX/PTT/TX switch to VOX and odjust R79 on the Low Level Board fully anti-clockwise, and check that the output of the MA.1720 is muted after approximately 2 seconds. Adjust R79 clockwise until the MA.1720 de-mutes.

NOTE: For speech input the clockwise setting of R79 may hove to be increased.

(14) Set the Audio Signal Generator output to 0dB, set the MODE SELECTOR to ISB-26 and check that the output level falls by 6dB.

(15) Insert the audio signal into LINE 2 jack socket, set the METER switch to LINE 2 and check that the front panel meter reods 0dBm.

(16) Set the METER switch to SET 2 and adjust the SET LINE 2 potentiometer clockwise until the front panel meter reads 0dBm.

(17) Set the MODE SELECTOR switch to ISB-26 ond the METER switch to RF. Increase the oudio output by 10dB and adjust R75 on the Low Level Board to obtain a reading of -6dB relative to the 200mW setting on the front panel meter.

Setting-up Tone Oscillator

12. (1) Set the TUNE/MUTE/OPERATE switch to OPERATE HIGH.

(2) Set the MODE SELECTOR switch to CW.

(3) Set the VOX/PTT/TX switch to TX.

(4) Set the FREQUENCY switches to 2MHz and press the RESET push-button.

(5) Insert the Key into a front-panel jack and earth the Key line (Key down condition).

(6) In the Key down condition adjust R65 on the Low Level Board to obtain a reading of 200mW on the front panel meter.

(7) Use the Frequency Meter to measure the output frequency at socket SK4 on the rear panel. The frequency should be 1.999MHz in the Key down condition. If necessary, adjust transformer T1 on the Law Level Board.

Setting-Up RTTY Facility

13. (1) Set the MODE SELECTOR switch to RTTY TEST and the SIDEBAND SELECTOR switch to UPPER.

(2) Remave link LK1 an the RTTY Generatar Baard and use the Frequency Meter ta measure the output at sacket SK4 on the rear panel. The measured frequency shauld be 2.0020MHz, if nat adjust R22 on the RTTY Generatar Baard.

(3) Replace link LK1 in the A-B pasition af the RTTY Generatar Board.

(4) Adjust R31 on the RTTY Generator Board for a maximum reading of 200mW on the frant panel meter.

(5) The required frequency shift is obtained by adjustment of R15 on the RTTY Generator Board. If for example a frequency shift af 400Hz is required, R15 shauld be adjusted ta abtain an autput frequency af 2.0024MHz i.e. 400Hz abave previous autput frequency.

(6) Switch the MODE SELECTOR switch to RTTY and check that the output frequency is 2.0016MHz.

Tune Level

14. Switch the TUNE/MUTE/OPERATE switch to TUNE and adjust R204 on the Low Level Board for o reading of -6dB relative to the 200mW setting an the frant panel meter.

Mixer Drive Level

15. (1) Set the TUNE/MUTE/OPERATE switch ta OPERATE HIGH and connect the oscilloscape or Electronic valtmeter ta pin 8 and pin 9 (earth) on the Mixer and Output Board.

(2) Adjust R44 an the H.F. Loop Board PS337 ta abtain a reading af 224mV ± 10mV.

FAULT LOCATION

Procedure

16. If a fault is suspected, first check that the front panel controls are correctly set for the mode of operation required, then check the setting of the INTERNAL/EXTERNAL Frequency Standard Selector switch on the rear panel.

Power Supply Board PM343

17. Check the supply voltages, using the front panel meter (Chap.3 para.8) and adjust if necessary. If any power supplies are missing, check the inputs to the Power Supply Board using the multimeter:

Pin 17	+30V d.c.
12	+18V d.c.
6	+10V d.c.
22	+4.5V d.c.

Mixer and Output Board PM342

18. Using the oscilloscope, check RF levels at the collectors of all transistors on the Mixer and Output Board. Using the electronic voltmeter, check d.c. levels at the emitters of all transistors on the board. Representative values are given below.

Transistor	Emitter V d.c.	Collector V p-p
TR13	5.8	16.0
TR12	5.6	7.5
TR11	2.8	4.0
TR10	2.6	1.6
TR9	2.6	0.8
TR15	8.0	0.3
TR6	3.2)	15-20 at 35-60MHz
TR5	4.0)	
TR8	6.0	1.0
TR3	3.2)	15-20 at 35.4MHz
TR2	4.0)	

19. Adjustment of Low Pass Filter. If misalignment is suspected (symptom - excessive breakthrough of 2nd local oscillator, 35.4 - 65.4MHz), the fallawing pracedure should be adopted.

(1) Monitor the RF output [illegible]he MA.[illegible]0 on the spectrum analyser.

(2) Set the MODE SELECT [illegible]witch ta[illegible] suppressed, and ensure that the MA.1720 is not muted [illegible]e [illegible] is up.

(3) Set the frequency switches to 02.0200MHz. Press the RESET push-button and adjust L9 on PM342 for minimum output at 37.42MHz.

(4) Set the frequency switches to 00.1000MHz. Press the RESET push-button and adjust L10 on PM342 for minimum output at 35.5MHz.

(5) Set the frequency switches to 08.7700MHz. Press the RESET push-button and adjust L11 on PM342 for minimum output at 44.17MHz.

(6) Set the frequency switches to 29.9999MHz, and set the TUNE/MUTE/OPERATE switch to TUNE. Press the RESET push-button and adjust L8 on PM342 for maximum output at 30MHz.

20. Using the oscilloscope, check the 1.4MHz input to the Mixer and Output Board PM342 at pin 4. The level should be 600mV p-p approximately. If there is no signal at this point, check the Low Level Board as in the following paragraphs.

Low Level Board PM341

21. Select CW on the MODE switch. Using the oscilloscope, check pin 16 on the Law Level Board for the presence of a 1.4MHz signal of approximately 600mV p-p. If there is no signal, check the 1.4MHz Generator on the Synthesizer Board as detailed in para.68.

22. If a signal is present at pin 16, check the signal at TP5 for approximately 620mV p-p using the oscilloscope, then check the collectors of TR41 and TR42 using the oscilloscope. A squarewave of approximately 4V p-p should be present.

23. Using the oscilloscope, check that a sinewave of approximately 1V p-p is present at TR57 collector.

24. Select 'KEY supp' on the MODE switch and repeat the tests of paras.22 and 23 for the same results.

25. Select 'KEY -6' on the MODE switch. Using the electronic voltmeter, check that the voltage at pin 45 is not less than +10V d.c., and that +5.5V d.c. is present at TR50 collector.

26. Select 'RTTY' on the MODE switch. Using the multimeter, check that +10V d.c. is present at pin 21. Using the oscillascope, check that a squarewave of 50mV p-p at a frequency of approximately 2kHz is present at pin 24.

27. Select any SSB mode on the MODE switch and test the following points for the results shown:

TR2 collector +15V d
TR3 collector -5.6V Using the electronic voltmeter

Pin 38	300mV p-p audio	)	
TR12 collector	10mV p-p audio	)	Using the oscilloscope
TP2	2.5V p-p audio	)	

28. Select 'ISB' on the MODE switch and test the following points for the results shown:

Pin 29	+10V d.c.	)	
TR4 collector	+15V d.c.	)	Using the electronic voltmeter
TR5 collector	-5.6V d.c.	)	
Pin 32	300mV p-p audio	)	
TR13 collector	10mV p-p audio	)	Using the oscilloscope
TP3	2.5V p-p audio	)	

29. To check the meter circuit, test the following points for the results shown:

Pin 15	100mV p-p audio	)	Using the oscilloscope
TR64 collector	1.5V p-p squarewave	)	

RTTY Board PM340

30. To check the operotion of the RTTY Board, corry out the following tests for the results shown:

MODE Switch Setting	Test Point	Reading	Test Instrument
'RTTY Test'	Pin 5	not less than +10V d.c.	Multimeter
'RTTY'	Pin 5	-4V d.c.	Multimeter
'RTTY Test'	TR2 collector	+15V to +20V d.c.	Electronic Voltmeter
'RTTY'	TR2 collector	0V	Electronic Voltmeter
'RTTY Test'	TR3 collector	0V	Electronic Voltmeter
'RTTY'	TR3 collector	+15V to +20V d.c.	Electronic Voltmeter

31. Remove the link LK1 and check the tone oscillator by monitoring TP3 with the oscilloscope. A 2kHz squarewave with an amplitude of approximately 4V p-p should be displayed.

32. Select 'RTTY Test' on the MODE switch. Monitor TP3 with the oscilloscope, insert link LK1 in position A-C and check that the oscillator frequency increases above 2kHz. Change the link to position A-B and check that the oscillator frequency falls below 2kHz.

33. (1) Connect the multimeter between pin 30 (positive lead) and pin 22 (negative lead). Operate the RESET push button and hold in positian, the multimeter should indicate +12V d.c.

(2) If the front panel LOCK lomp is extinguished use the oscilloscope to monitor pins 25, 26 and 27; if the synthesizer is in the lock condition a constant +5V d.c. will appear at each pin.

(3) If the synthesizer is locked i.e. +5V d.c. is present at pins 25, 26 and 27, use the multimeter to check for 0V on pin 3 and +12V on pin 31 of the Control Board.

(4) Set the TUNE/MUTE/OPERATE switch to MUTE and use the multimeter to check for 0V on pin 5.

(5) Select C.W. Keyed on the MODE SELECTOR and check for approx. +10V d.c. ot pin 5.

(6) Set the VOX/PTT/TX switch to TX ond check for opprox. +10V d.c. ot pin 5.

(7) Set the TUNE/MUTE/OPERATE switch to TUNE and check for opprox. +10V d.c. ot pin 5.

(8) Depress the STANDBY push button ond check for 0V at pin 14.

(9) Depress the E.H.T. READY push button and check for 0V ot pin 16.

(10) Apply in turn the inputs shown below to the pins indicated. Connect the negotive lead of the multimeter to pin 22 and use the positive lead to monitor the output pins shown. Check that the specified voltoges ±0.5V are indicoted.

Apply Input to Pin		Monitor Output from Pin	
Eorth	1	0V	4
		+12V	32
		0V	5
+12V	6	0V	7
		+12V	33
Earth	8	0V	10
		+12V	34
		+12V	12

Noise Immunity Board PM346

34. If the output frequency of the MA.1720 is suspect, the following checks should be made to the Noise Immunity Board by selecting, in turn, each digit of the ranges on the FREQUENCY SELECTOR switch. The Binary Coded Decimal (BCD) inputs to the Control Board are quoted for test purposes and a BCD Truth Table is provided to enable conversion from BCD to the digit selected. In the 1MHz and 10MHz ranges, the '9's complement system is used and it should be remembered that to obtain the relevant BCD inputs, the digit selected on the FREQUENCY SELECTOR switch must first be subtracted from 9 i.e. 2 selected, 9 - 2 = 7 therefore the relevant BCD inputs are 1, 2 and 4.

NOTE: The frequency lines from the FREQUENCY SELECTOR switches are coded in inverted BCD and nines complement code. This is how they appear at the inputs to the Noise Immunity Board. An inversion occurs within the Noise Immunity Board, therefore the outputs to the Synthesizer and the HF Loop and Transfer Loop are normal BCD (to the Synthesizer) and nines complement code (to the Loops).

BCD Truth Table

Digit	'1'	'2'	'4'	'8'
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1

Note: '0' = 0.2V approximately
'1' = +12V approximately

35. As will be seen from the circuit diogram (Fig. 12), the logic state at each output pin should be the inverted input logic.

Range	BCD Function	Input Pin	Output Pin
100Hz	1	8	7
	2	6	5
	4	4	3
	8	2	1
1kHz	1	16	15
	2	14	13
	4	12	11
	8	10	9
10kHz	1	24	23
	2	22	21
	4	20	19
	8	18	17
100kHz	1	32	31
	2	30	29
	4	28	27
	8	26	25
1MHz	1	40	39
	2	38	37
	4	36	35
	8	34	33
10MHz	1	48	47
	2	46	45
	4	44	43
	8	42	41

34MHz Generator Board PM344

36. To check this board, monitor pin 8 with the oscilloscope and ensure that the 5MH. input is present at a level af appraximately 800mV p-p. Transfer the oscilloscope to the following paints in turn and check that the specified autputs are obtained.

Test Point	Output
Pin 10	1MHz squarewave, 1V p-p
Pin 12	1MHz squarewave, 4V p-p
TR4 collector	34MHz sinewave, greater than 500mV p-p
ML1 pin 6	34MHz sinewave, 4V p-p
ML2 pin 8)	1MHz squarewave, 4V p-p
ML4 pin 8)	
ML6 pin 6	-ve [illegible] 4V at 1MHz

37. Monitor the voltage at board pin 2 with the multimeter, and check that the level is +4V d.c.; adjust L1 if necessary.

H.F. Loop Board PS337

38. Switch the MHz switch on the front ponel ta the fallawing ranges and check that the correct oscillator is selected by monitoring the pins on the p.c.b.

MHz Range	Pin No.	Reading
0-7MHz	28	0V
8-17MHz	27	0V
18-29MHz	26	0V

39. Check thot the selected oscillator is operating by using the oscilloscope to measure o 3V p-p signal at TP4.

40. Check the shaping circuit, TR11 and TR12, by using the oscilloscope to check the signal at the collector of TR12. The squarewove signal should have an excursion from 0.4V to ot leost +3V p-p.

41. Use the oscilloscope to check the divide by two circuit ML2, by monitoring the input ot the collector of TR12 and the output at TP5.

42. Use the oscilloscope to check the strobe pulse at TP6. The negative going pulse should be of 90 ns to 180 ns duration with a p.r.f. of approximately 400kHz.

43. Use the delayed time base facility on the oscilloscape to check the divider ratio. Trigger the oscilloscope from TP6 and count the number of input pulses to produce one output pulse.

44. Use the oscilloscope to check the operotion of the Transfer Oscillator of TP12. The squarewave pulse should have on excursion from 0.4V to ot least +3V p-p.

45. Use the oscilloscope to check the phase camparator outputs. Negative going pulses of 30 ns duration should be obtained at TP7 and TP8 when the loop is locked. When the loop is out of lock, one test point should have the negative going 30 ns pulse whilst the other should have a pulse of cyclically vorying width.

46. Use the multimeter to check the d.c. voltage at the collector of TR19. When the loop is locked the voltoge should be between +3 and +14V d.c. When TP7 hos the pulse of cyclically varying width the voltage should be approximately +2.3V d.c. When TP8 has the pulse of cyclically varying width the voltoge should be approximately +19V d.c.

47. Use the oscilloscope to check the lock indicator. When the loop is locked TP9 and TP11 should have negative going pulses of 1.5 ns duration at a p.r.f. of approximately 400kHz. When the loop is out of lock the pulse of cyclically varying width at TP7 or TP8 should also appear at TP12 except during the period of the negative going 1.5 ns pulse at TP9 and TP11.

Transfer Board PS338

NOTE: The following checks on the Tronsfer Board should be carried out when the board is used in conjunction with the oscillator on the H.F. Loop Board.

48. Use the oscilloscope to check the voltage ot the collector of TR2 which is produced by the 1MHz frequency standard input. The voltage should be opproximotely 300mV p-p.

49. Use the oscilloscope to check the signol ot the collector of TR3 which is produced by the Transfer Oscillotor input. The signal level should be approximotely 1V p-p in the frequency ronge 885-948kHz.

50. Use the oscilloscope to check the mixer output ot the collector of TR6. The signal should hove on excursion from +0.4V to ot least +3V p-p.

51. Use the oscilloscope to check the signal on TP1 which should have on excursion from +0.4V to ot least +3V p-p.

52. Use the oscilloscope to check the signal at TP6 which should be o negative going pulse with on excursion from +0.4V to at leost +3V p-p, with o durotion of opproximotely 250-300 ns.

53. Use the deloyed time base focility on the oscilloscope to check the divider rotio by triggering the oscilloscope from TP9 ond counting the number of input pulses to produce one output pulse.

54. Use the oscilloscope to check for negative going pulses of 30 ns durotion ot TP3 ond pin 6 of ML8 in the lock condition. In the out of lock condition either TP3 or pin 6 of ML8 will hove negative going pulses of 30 ns durotion whilst the other will have negotive going pulses of cyclically varying widths.

55. Use the multimeter to check the d.c. voltage at TR10 collector. In the lock condition this should be in the ronge +3V to +8V d.c. When pin 6 of ML8 has a pulse of cyclically varying width this voltoge should be approximotely +11V d.c. (out of lock condition).

56. Use the oscilloscape to check the lock indicator. In the lock condition the signals ot TP4 ond TP5 should be negative going pulses with on excursion of +3V to 0.4V with o durotion of 1.5µs.

57. In the out of lock condition the pulse of cyclically vorying width ot TP3 or pin 6 of ML8 should also oppear ot pin 6 of the Tronsfer Board except during the period of the negative going 1.5µs pulse ot TP4 and TP5.

58. Use the multimeter to check the oscillator supply; the voltage at the emitter of transistor TR1 should measure +5V d.c. ± 0.25V.

59. Use the oscilloscope to check the oscillator output at TP1. A TTL squarewave signal in the frequency range 18-23MHz should be obtained.

60. Use the oscilloscope to check the strobe pulse at TP4. The negative going pulses should have a duration of 80-100 ns.

61. Use the oscilloscope to check the strobe pulse at TP2. The positive going pulses should be of approximately 50 ns duration.

NOTE: If the positive going 50 ns pulses are not obtained at TP2, the input and output pins of ML5, ML8, ML13 and ML16 should be monitored to isolate the faulty package in the divider chain.

62. Use the oscilloscope to check the divide by five package ML5. The TTL signal at pin 2 of ML5 should be in the frequency range 3.6 - 4.6MHz.

63. Transfer the oscilloscope to pin 12 of ML1 to check the buffer stage, gate G1 of ML1. The signal should be in the frequency range 3.6 - 4.6MHz.

64. Use the oscilloscope to check the Divide-by-2000 stage at TP3. The signal should be a square waveform at 500Hz.

NOTE: If the 500Hz square waveform is not obtained at TP3, the input and output pins of ML3, ML4, ML7 and ML10 should be monitored to isolate the faulty package in the divider chain.

65. Use the oscilloscope to check the phase comparator outputs. Positive going pulses of 50 ns duration should be obtained at the Q outputs (pin 5 and pin 9) of ML12(a) and ML12(b) when the loop is locked. In the out of lock condition pin 5 or pin 9 should have a negative going 50 ns pulse whilst the other pin should have a pulse of cyclically varying width.

66. Use the multimeter to check the supply to the Varactor Line Driver at the emitter of transistor TR10. The voltage should be +19.5V d.c. ± 0.5V.

67. Transfer the multimeter to check the Varactor Line Driver at TP5. When the loop is locked the voltage should be between ± 3.5 and +15V d.c. depending on the frequency selected. When the Q output (pin 5) of ML12 (a) has the pulse of cyclically varying width the voltage should be approximately +15V d.c. When the Q output (pin 9) of ML12 (b) has the pulse of cyclically varying width the voltage should be appraximately +18V d.c.

68. Use the oscilloscope to check the 1.4MHz Generotor. The signol ot pin 9 af ML3 should be o squore waveform with on excursion from 0.4V to ot least +3V p-p.

69. Tronsfer the oscilloscope to the base of TR3. A sine wave signal of appraximotely 500mV peak to peak should be obtained.

70. Transfer the oscilloscope to pins 1 ond 2 of the printed circuit board. The output of the 1.4MHz Generotor should be opproximately 640mV p-p when the generotor is correctly terminoted.

CHAPTER 6

COMPONENTS LIST

CONTENTS

Component Values

Component values are quated as follows:-

Resistors:	No suffix	=	ohms
	Suffix 'k'	=	kilohms
	Suffix 'M'	=	megohms
Capacitors:	No suffix	=	microfarads
	Suffix 'p'	=	picofarads

Cct. Ref.	Value	Description	Rat	Tal %	Racal Part Number	Manufacturer
		CHASSIS ASSEMBLY FIG.28				
		Resistors				
R1	2.2	Wirewound	6	5	920841	Welwyn W22
R2	2.2	Wirewound	6	5	920841	Welwyn W22
R2	2.2	Wirewound	6	5	920841	Welwyn W22
R4	2.2	Wirewound	6	5	920841	Welwyn W22
		Capacitors				
C1	10000	Fixed	40V		919351	Mullard 106 17103
C2	10000	Fixed	16V		914059	Mullard 101 15103
C3	6800	Fixed	25V		920633	Mullard 106 16682
C4	10000	Fixed	16V		914059	Mullard 106 15103
C5*	.033	Ceramic	18V		911883	Erie 831/18V/33k
C6*	.033	Ceramic	18V		911883	Erie 831/18V/33k
C7*	.033	Ceramic	18V		911883	Erie 831/18V/33k
C8*	.033	Ceramic	18V		911883	Erie 831/18V/33k
C9*	.033	Ceramic	18V		911883	Erie 831/18V/33k
C10*	.033	Ceramic	18V		911883	Erie 831/18V/33k
C11*	.033	Ceramic	18V		911883	Erie 831/18V/33k
C12*	.033	Ceramic	18V		911883	Erie 831/18V/33k
C13*	.033	Ceramic	28V		911883	Erie 831/18V/33k
C14	0.1	Palycarbonate	100V	20	914173	STC PMC2R/0.1/M100
C15	0.1	Palycarbonate	100V	20	914173	STC PMC2R/0.1/M100
C16	68p	Palystyrene	30V	2½	908321	Suflex HS7A
C17	68p	Palystyrene	30V	2½	908321	Suflex HS7A
C18	68p	Palystyrene	30V	2½	908321	Suflex HS7A
C19	68p	Palystyrene	30V	2½	908321	Suflex HS7A
		Transformers				
T1					CT604660	Racal
T2					CT604660	Racal
T3					CT603590	Racal

* Mounted on Line Decaupling Board PS392 (see Fig.27)

Cct. Ref.	Volue	Description	Rot	Tol %	Rocal Port Number	Manufocturer
		Tronsistors				
TR1		Silicon n-p-n			915654	Mullord 2N3055
TR2		Silicon n-p-n			915654	Mullard 2N3055
TR3		Silicon n-p-n			915654	Mullord 2N3055
TR4		Silicon n-p-n			915654	Mullord 2N3055
		Diodes				
D1		Rectifier Bridge			916522	I.R.Ltd. 3SB10
D2		Rectifier Bridge			916522	I.R.Ltd. 3SB10
D3		Rectifier Bridge			916522	I.R.Ltd. 3SB10
D4					914898	ITT 1N4149
D5					914898	ITT 1N4149
D6					914898	ITT 1N4149
D7					914898	ITT 1N4149
D8					914898	ITT 1N4149
D9					914898	ITT 1N4149
D10					914898	ITT 1N4149
D11					914898	ITT 1N4149
D12					914898	ITT 1N4149
D13					914898	ITT 1N4149
D14					914898	ITT 1N4149
D15					914898	ITT 1N4149
D16					914898	ITT 1N4149
D17					914898	ITT 1N4149
D18					914898	ITT 1N4149
D19					914898	ITT 1N4149
D20					914898	ITT 1N4149
D21					914898	ITT 1N4149
D22					914898	ITT 1N4149
D23					914898	ITT 1N4149
D24					914898	ITT 1N4149
D25					914898	ITT 1N4149
D26					914898	ITT 1N4149
D27					914898	ITT 1N4149
D28	6.2V				918984	Mullard BZY96-C6V2

Cct. Ref.	Value	Description	Rat	Tal %	Racal Part Number	Manufacturer
		Filters				
F1		Crystal Filter 3kHz USB			998044	Racal
		or Crystal Filter 6kHz USB			998617	Racal
F2		Crystal Filter 3kHz LSB			998043	Racal
		or Crystal Filter 6kHz LSB			998617	Racal
		Relay				
RLA		Miniature			918042	ITT Type 25
		Fuses				
FS1	500mA				911834	Beswick TDC134
FS2	2A				905169	Belling Lee L693
		Connectors				
SK1		Connector 37 way			915656	Cannon DC37S
SK2		Connector 37 way			915656	Cannon DC37S
SK3		Connector Coaxial			919499	Suhner BNC
SK4		Connector Caaxial			919499	Suhner BNC
SK5		Connector Coaxial			900061	Suhner BNC
SK6		Connector 15 way			900905	McMurdo DA-155
SK7A-7F		Connector			920640	Contraves CV400-215
SK8		Valve holder B7G			921654	McMurdo XM7/U.3
SK9		Connector 25 way			915970	Cannon DB25S
		Switch				
SM		Slide Switch			912063	EMI D.P.C.O. 55
SN		Multiswitch			AD603194	Racal
		Voltage Selector				
VS1		12 way			906385	McMurdo B279002A
		Boards				
PS337/3		H.F. Loop			DA44978/C	Racal
PS338		Transfer Loop			DA44981/A	Racal
PM340		RTTY Generatar			CA603235	Racal
PM341		Low Level			BA603030	Racal
PM342		Mixer and Output			DA603034	Racal
PM343		Power Supply			CA603038	Racal
PM344		34MHz Generator			DA603042	Racal
PM345		Control			BA603046	Racal
PM346		Noise Immunity			CA603050	Racal
PM349		Frequency Synthesizer			DA76483	Racal

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		FRONT PANEL ASSEMBLY FIG.23				
		Resistors				
R1	180k	Metal Oxide	1/4	2	920644	Electrosil TR4
R2	68k	Metal Oxide	1/4	2	916478	Electrosil TR4
R3	100k	Metal Oxide	1/4	2	915190	Electrosil TR4
R4	56k	Metal Oxide	1/4	2	913497	Electrosil TR4
R5	15k	Metal Oxide	1/4	2	920645	Electrasil TR4
R6	10k	Metal Oxide	1/4	2	914042	Electrosil TR4
R7	330	Metal Oxide	1/4	2	915690	Electrasil TR4
R8	10k	Metal Oxide	1/4	2	914042	Electrosil TR4
R9	330	Metal Oxide	1/4	2	915690	Electrasil TR4
R10	Not Used					
R11	10k	Linear			920643	Colvern CLR 1225/98
R12	10k	Linear			920643	Colvern CRR 1225/98
R13	22	Metal Oxide	1/4	2	920743	Electrosil TR4
R14	220	Wirewound	2½	5	913604	Welwyn W21
		Copacitor				
C1	.033	Ceramic	18V	+50 -25	911883	Erie 831/T/18V
		Diodes				
D1					914898	Mullard 1N4149
D2					914898	Mullard 1N4149
D3					914898	Mullard 1N4149
D4					914898	Mullard 1N4149
D5					914898	Mullard 1N4149
		Lamps				
LP1			0.1A		910188	Hivac BPO 2
LP2			0.1A		910188	Hivac BPO 2
LP3			0.1A		910188	Hivac BPO 2
LP4			0.1A		910188	Hivac BPO 2
LP5			0.1A		910188	Hivac BPO 2
LP6			0.1A		910188	Hivac BPO 2

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Switches				
SA		Control Switch			603159	
SB		Mode Switch			603160	
SC		Function Switch			603158	
SD		Meter Switch			603161	
SE		Key Switch Non-Locking			996659	
SF		Key Switch Locking			996640	
SG		Key Switch Locking			996640	
SH		Key Switch Miniature			920641	
SJ		Key Switch Locking			996639	
SL		Key Switch Miniature			917197	
		Connectors				
JK1		Connector Jack Socket			920642	Rendar R41414
JK2		Connector Jack Socket			920642	Rendar R41414
PL1		Connector Plug 37 woy			916507	Cannon DC37P
SK1		Connector Socket 37 woy			915656	Cannon DC37S

Cct. Ref.	Value	Description	Rot	Tol %	Racal Part Number	Manufacturer
		H.F. LOOP BOARD PS337/3 FIG.7				
		Resistors				
R1	100k	Composition	1/3	10	919163	Vitrohm 103-6
R2	47k	Composition	1/3	10	919188	Vitrohm 103-6
R3	22k	Composition	1/3	10	918074	Vitrohm 103-6
R4	100k	Composition	1/3	10	919163	Vitrohm 103-6
R5	47k	Composition	1/3	10	919188	Vitrohm 103-6
R6	22k	Composition	1/3	10	918074	Vitrohm 103-6
R7	100k	Composition	1/3	10	919163	Vitrohm 103-6
R8	47k	Composition	1/3	10	919188	Vitrohm 103-6
R9	22k	Composition	1/3	10	918074	Vitrohm 103-6
R10	220	Composition	1/3	10	919174	Vitrohm 103-6
R11	220	Composition	1/3	10	919174	Vitrohm 103-6
R12	220	Composition	1/3	10	919174	Vitrohm 103-6
R13	680	Composition	1/3	10	919191	Vitrohm 103-6
R14	680	Composition	1/3	10	919191	Vitrohm 103-6
R15	680	Composition	1/3	10	919191	Vitrohm 103-6
R16	220	Composition	1/3	10	919174	Vitrohm 103-6
R17	680	Composition	1/3	10	919191	Vitrohm 103-6
R18	220	Composition	1/3	10	919174	Vitrohm 103-6
R19	680	Composition	1/3	10	919191	Vitrohm 103-6
R20	220	Composition	1/3	10	919174	Vitrohm 103-6
R21	680	Composition	1/3	10	919191	Vitrohm 103-6
R22	1k	Composition	1/3	10	918075	Vitrohm 103-6
R23	220	Composition	1/3	10	919174	Vitrohm 103-6
R24	390	Composition	1/3	10	919184	Vitrohm 103-6
R25	470	Composition	1/3	10	919187	Vitrohm 103-6
R26	10k	Composition	1/3	10	918073	Vitrohm 103-6
R27	10k	Composition	1/3	10	918073	Vitrohm 103-6
R28	220	Composition	1/3	10	919174	Vitrohm 103-6
R29	330	Composition	1/3	10	919179	Vitrohm 103-6
R30	10k	Composition	1/3	10	918073	Vitrohm 103-6
R31	150	Composition	1/3	10	919189	Vitrohm 103-6
R32	100	Composition	1/3	10	918076	Vitrohm 103-6
R33	330	Composition	1/3	10	919179	Vitrohm 103-6
R34	100k	Composition	1/3	10	919163	Vitrohm 103-6
R35	220	Composition	1/3	10	919174	Vitrohm 103-6

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Resistors (Contd.)				
R36	1k	Composition	1/3	10	918075	Vitrohm 103-6
R37	4.7k	Composition	1/3	10	919165	Vitrohm 103-6
R38	10k	Variable cermet		20	921181	Morganite 90H
R39	1.5k	Composition	1/3	10	919180	Vitrohm 103-6
R40	4.7k	Composition	1/3	10	919165	Vitrohm 103-6
R41	4.7k	Composition	1/3	10	919165	Vitrohm 103-6
R42	4.7k	Composition	1/3	10	919165	Vitrohm 103-6
R43	680	Composition	1/3	10	919191	Vitrohm 103-6
R44	1k	Variable cermet		20	923061	Morganite 90H
R45	390	Composition	1/3	10	919184	Vitrohm 103-6
R46	470	Composition	1/3	10	919187	Vitrohm 103-6
R47	4.7k	Composition	1/3	10	919165	Vitrohm 103-6
R48		Not Used				
R49	4.7k	Composition	1/3	10	919165	Vitrohm 103-6
R50		Not Used				
R51	4.7k	Composition	1/3	10	919165	Vitrohm 103-6
R52		Not Used				
R53		Not Used				
R54	4.7k	Composition	1/3	10	919165	Vitrohm 103-6
R55		Not Used				
R56		Not Used				
R57		Not Used				
R58		Not Used				
R59		Not Used				
R60	2.2k	Composition	1/3	10	919169	Vitrohm 103-6
R61	47	Composition	1/3	10	919622	Vitrohm 103-6
R62	3.3k	Composition	1/3	10	919168	Vitrohm 103-6
R63	100	Composition	1/3	10	918076	Vitrohm 103-6
R64	680	Composition	1/3	10	919191	Vitrohm 103-6
R65	2.2k	Composition	1/3	10	919169	Vitrohm 103-6
R66	220	Composition	1/3	10	919174	Vitrohm 103-6
R67	3.3k	Composition	1/3	10	919168	Vitrohm 103-6
R68	470	Composition	1/3	10	919187	Vitrohm 103-6
R69	2.2k	Composition	1/3	10	919169	Vitrohm 103-6
R70	18k	Composition	1/3	10	919621	Vitrohm 103-6

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Resistars (Contd.)				
R71	1k	Composition	1/3	10	918075	Vitrahm 103-6
R72	10k	Composition	1/3	10	918073	Vitrohm 103-6
R73	680	Compositian	1/3	10	919191	Vitrahm 103-6
R74	2.2k	Compasition	1/3	10	919169	Vitrahm 103-6
R75	1.5k	Composition	1/3	10	919180	Vitrahm 103-6
R76	3.3k	Compositian	1/3	10	919168	Vitrahm 103-6
R77	2.2k	Compasition	1/3	10	919169	Vitrohm 103-6
R78	100	Compasition	1/3	10	918076	Vitrohm 103-6
R79	680	Compasition	1/3	10	919191	Vitrahm 103-6
R80	56	Compositian	1/3	10	919185	Vitrahm 103-6
R81	56	Campasition	1/3	10	919185	Vitrahm 103-6
R82	4.7k	Compasitian	1/3	10	919165	Vitrahm 103-6
		Capacitors				
C1	.001	Ceramic	500V	20	915243	Erie 831K 2600
C2	.001	Ceramic	500V	20	915243	Erie 831K 2600
C3	.001	Ceramic	500V	20	915243	Erie 831K 2600
C4	.001	Ceramic	500V	20	915243	Erie 831K 2600
C5	.001	Ceramic	500V	20	915243	Erie 831K 2600
C6	.001	Ceramic	500V	20	915243	Erie 831K 2600
C7	100p	Ceramic	500V	10	917417	Erie 831N 3300
C8	100p	Ceramic	500V	10	917417	Erie 831N 3300
C9	100p	Ceramic	500V	10	917417	Erie 831N 3300
C10	.001	Ceramic	500V	20	915243	Erie 831K 2600
C11	.001	Ceramic	500V	20	915243	Erie 831K 2600
C12	.001	Ceramic	500V	20	915243	Erie 831K 2600
C13	.001	Ceramic	500V	20	915243	Erie 831K 2600
C14	.001	Ceramic	500V	20	915243	Erie 831K 2600
C15	.001	Ceramic	500V	20	915243	Erie 831K 2600
C16	.001	Ceramic	500V	20	915243	Erie 831K 2600
C17	.001	Ceramic	500V	20	915243	Erie 831K 2600
C18	.001	Ceramic	500V	20	915243	Erie 831K 2600
C19	.001	Ceramic	500V	20	915243	Erie 831K 2600
C20	.01	Ceramic	500V	+50 -25	911845	Erie 831/T/25V

Cct. Ref.	Value	Description	Rat	Tal %	Racal Part Number	Manufacturer
		Capacitors (Contd.)				
C21	.1	Polycarbonate	100V	20	914173	STC PMC2R/0.1/ M100
C22	.001	Ceramic	500V	20	915243	Erie 831K 2600
C23	100p	Ceramic	500V	10	917417	Erie 831N 3300
C24	.001	Ceramic	500V	20	915243	Erie 831K 2600
C25	0.1	Polycarbonate	100V	20	914173	STC PMC2R/0.1/ M100
C26	.001	Ceramic	500V	20	915243	Erie 831K 2600
C27	.001	Ceramic	500V	20	915243	Erie 831K 2600
C28	6.8	Tantalum	35V	20	921179	Union Carbide K6R8E35
C29	100p	Ceramic	500V	10	917417	Erie 831 N3300
C30	0.1	Polycarbonate	100V	20	914173	STC PMC2R/0.1/ M100
C31	.01	Ceramic	25V	+50 -25	911845	Erie 831/T/25V
C32	.001	Ceramic	500V	20	915243	Erie 831K 2600
C33	0.1	Polycarbonate	500V	20	914173	STC PMC2R/0.1/ M100
C34	.033	Ceramic	18V	+50 -25	911883	Erie 831/T/18V
C35	.033	Ceramic	18V	+50 -25	911883	Erie 831/T/18V
C36	.001	Ceramic	500V	20	915243	Erie 831K 2600
C37	.033	Ceramic	18	+50 -25	911883	Erie 831/T/18V
C38	0.1	Polycarbonate	500V	20	914173	STC PMC2R/0.1/ M100
C39	0.1	Polycarbonate	500V	20	914173	STC PMC2R/0.1/ M100
C40	.001	Ceramic	500V	20	915243	Erie 831K 2600
C41	.001	Ceramic	500V	20	915243	Erie 831K 2600
C42	.001	Ceramic	500V	20	915243	Erie 831K 2600
C43	.033	Ceramic	18V	+50 -25	911883	Erie 831/T/18V
C44	.001	Ceramic	500V	20	915243	Erie 831K 2600
C45	.033	Ceramic	18V	+50 -25	911883	Erie 831/T/18V

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Capacitors (Contd.)				
C46		Not Used				
C47	.033	Ceramic	18V	+50 -25	911883	Erie 831/T/18V
C48		Not Used				
C49		Not Used				
C50	.001					
C51	6.8	Tantalum	35V	20	921179	Union Carbide K6R8E35
C52	.033	Ceramic	18V	+50 -25	911883	Erie 831/T/18V
C53	.033	Ceramic	18V	+50 -25	911883	Erie 831/T/18V
C54		Nat Used				
C55		Not Used				
C56	33	Tantalum	10V	20	921224	Union Carbide K33E10
C57		Nat Used				
C58		Nat Used				
C59	.001	Ceramic	500V	20	915243	Erie 831K 2600
C60	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C61	.033	Ceramic	18V	+50 -25	911883	Erie 831/T/18V
C62	100p	Ceramic	500V	10	917417	Erie 831N 3300
C63	.033	Ceramic	18V	+50 -25	911883	Erie 831/T/18V
C64	6.8	Tantalum	35V	20	921179	Union Carbide K6R8E35
C65	.001	Polystyrene	30V	2	921260	Suflex EP9
C66	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C67	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C68	6.8	Tantalum	35V	20	921179	Union Carbide K6R8E35
C69	.0033	Polystyrene	30V	2	921259	Suflex EP9
C70	.001	Polystyrene	30V	2	921260	Suflex EP9
C71	.001	Polystyrene	30V	2	921260	Suflex EP9
C72	33	Tantalum	10V	20	921224	Union Carbide K33E10
C73	82p	Polystyrene	30V	2	921066	Suflex EP9
C74	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C75	.001	Polystyrene	30V	2	921260	Suflex EP9

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Capacitors (Contd.)				
C76	.033	Ceramic	18V	+50 -25	911883	Erie 831/T/18V
C77	0.1	Polycarbonate	100V	20	915370	STC PMC 2R/0.1/M100
C78	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C79	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C80	.0033	Polystyrene	30V	2	921259	Suflex EP9
C81	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C82	.001	Ceramic	500V	20	915243	Erie 831K 2600
C83	33	Tantalum	10V	20	921224	Erie K33E105
C84	.001	Ceramic	500V	20	915243	Erie 831K 2600
C85	.01	Ceramic	25V	+50 -25	911845	Erie 831/T/25V
C86	.1	Ceramic	30V	+50 -25	906675	Erie 811/T/30V
C87	.1	Ceramic	30V	+50 -25	906675	Erie 811/T/30V
C88	.01	Ceramic	25V	+50 -25	911845	Erie 811/T/25V
		Inductors				
L1	15uH	Choke			915850	Delevan 1537-40
L2	15uH	Choke			915850	Delevan 1537-40
L3	15uH	Choke			915850	Delevan 1537-40
L4		Coil Assembly			CT45549	Racal
L5		Coil Assembly			CT45550	Racal
L6		Coil Assembly			CT45543	Racal
L7	4.7uH	Choke			919468	Delevan 1537-28
L8	4.7uH	Choke			919468	Delevan 1537-28
L9	4.7uH	Choke			919468	Delevan 1537-28
L10	4.7uH	Choke			919468	Delevan 1537-28
L11	4.7uH				919468	Delevan 1537-28
L12	1mH	Choke		5	919033	Delevan 2500-28
L13	1mH	Choke		5	919033	Delevan 2500-28
L14	4.7uH	Choke		5	919468	Delevan 1537-28
L15	4.7uH	Choke		5	919468	Delevan 1537-28

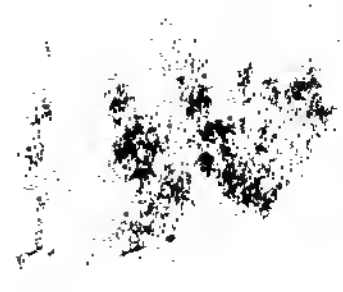
Cct. Ref.	Value	Description	Rat	Tol %	Rocal Part Number	Manufocturer
		Inductors (Contd.)				
L16		Not Used				
L17		Nat Used				
L18	4.7uH	Choke			919468	Delevon 1537-28
L19	1mH	Choke		5	919033	Delevon 2500-28
L20		Coil Assembly			CT45446	Rocal
L21	15uH	Choke			915850	Delevan 1537-40
L22	15uH	Choke			915850	Delevan 1537-40
L23	15uH	Choke			915850	Delevon 1537-40
L24	4.7uH	Choke			919468	Delevon 1537-28
L25	5.6uH	Choke			922275	Delevan 1537-30
		Transistars				
TR1		Silican n-p-n			915231	S.G.S. BFX48
TR2		Silicon n-p-n			915231	S.G.S. BFX48
TR3		Silicon n-p-n			915231	S.G.S. BFX48
TR4		F.E.T.			916946	Mullard BFW10
TR5		F.E.T.			916946	Mullord BFW10
TR6		F.E.T.			916946	Mullord BFW10
TR7		Silicon n-p-n			906842	Mullord 2N2369
TR8		Silicon n-p-n			906842	Mullord 2N2369
TR9		Silicon n-p-n			906842	Mullord 2N2369
TR10		Silicon n-p-n			916627	Mullord BFX89
TR11		Silicon n-p-n			906842	Mullard 2N2369
TR12		Silicon n-p-n			906842	Mullord 2N2369
TR13		Silicon n-p-n			914900	Mullard BC109
TR14		Silicon n-p-n			916627	Mullard BFX89
TR15		Nat Used				
TR16		Silicon n-p-n			906842	Mullard 2N2369
TR17		Silicon n-p-n			914900	Mullard BC109
TR18		Silicon n-p-n			915231	S.G.S. BFX48
TR19		Silicon n-p-n			906842	Mullard 2N2369
TR20		Silicon n-p-n			906842	Mullard 2N2369
TR21		Silicon n-p-n			914900	Mullard BC109

Cct. Ref.	Value	Description	Rat	Tal %	Racal Part Number	Manufacturer
		Diodes				
D1		Silicon			914898	STC 1N4149
D2		Silicon			914898	STC 1N4149
D3		Silicon			914898	STC 1N4149
D4		Silicon			920267	Ferranti ZC714
D5		Silicon			920267	Ferranti ZC714
D6		Silicon			920267	Ferranti ZC714
D7		Silicon			920267	Ferranti ZC714
D8		Silicon			920267	Ferranti ZC714
D9		Silicon			920267	Ferranti ZC714
D10		Silicon			914898	STC 1N4149
D11		Silicon			914898	STC 1N4149
D12		Silicon			914898	STC 1N4149
D13		Silicon			920062	H.P. 5082-2800
D14		Silicon			920062	H.P. 5082-2800
D15		Silicon			920062	H.P. 5082-2800
D16		Not Used				
D17		Not Used				
D18		Not Used				
D19		Silicon			920267	Ferranti ZC714
D20		Silicon			914898	STC 1N4149
D21		Silican			914898	STC 1N4149
D22		Silicon			914898	STC 1N4149
D23	4.7V	Zener			914067	Mullard BZY88C4V7
		Integroted Circuits				
ML1		Voltoge regulator			916155	Fairchild μA723C
ML2		Dual J-K Flip Flop			920332	Texas SN74 S112J
ML3		Decade Divider			920333	Signetics N8290A
ML4		8 input Nand gate			921266	Texas SN74 H21J
ML5		Decade Divider			920333	Signetics N8290A
ML6		Quad 2 input Nand gate			921221	Texas SN74 H00J
ML7		Dual D Flip Flop			917509	Transitron SN7474J
ML8		Manostable			921258	Transitron SN74121J
ML9		Dual J-K Flip Flop			921268	Texas SN74H103J
ML10		Dual D Flip Flop			917509	Transitron SN7474J
ML11		Monastable			921258	Transitron SN74121J
ML12		Dual D Flip Flop			917509	Transitron SN7474J

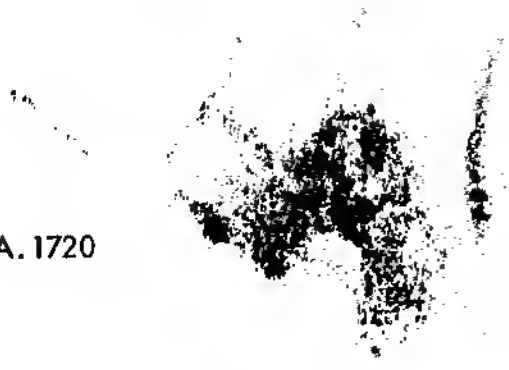
Cct. Ref.	Value	Description	Rot	Tol %	Rocal Part Number	Manufacturer
		TRANSFER LOOP BOARD PS338 FIG.9				
		Resistors				
R1	68	Composition	1/3	10	919186	Vitrohm 103-6
R2	470	Composition	1/3	10	919187	Vitrohm 103-6
R3	470	Composition	1/3	10	919187	Vitrohm 103-6
R4	100	Composition	1/3	10	918076	Vitrohm 103-6
R5	470	Composition	1/3	10	919187	Vitrohm 103-6
R6	47	Composition	1/3	10	919622	Vitrohm 103-6
R7	1k	Composition	1/3	10	918075	Vitrohm 103-6
R8	330	Composition	1/3	10	919179	Vitrohm 103-6
R9	330	Composition	1/3	10	919179	Vitrohm 103-6
R10	10	Composition	1/3	10	919173	Vitrohm 103-6
R11	1k	Composition	1/3	10	918075	Vitrohm 103-6
R12	68	Composition	1/3	10	919186	Vitrohm 103-6
R13	220	Composition	1/3	10	919174	Vitrohm 103-6
R14	100	Composition	1/3	10	918076	Vitrohm 103-6
R15	1k	Composition	1/3	10	918075	Vitrohm 103-6
R16	220	Composition	1/3	10	918174	Vitrohm 103-6
R17	10	Composition	1/3	10	919173	Vitrohm 103-6
R18	100	Composition	1/3	10	918076	Vitrohm 103-6
R19	470	Composition	1/3	10	919187	Vitrohm 103-6
R20	100	Composition	1/3	10	918076	Vitrohm 103-6
R21	68	Composition	1/3	10	919186	Vitrohm 103-6
R22	10	Composition	1/3	10	919173	Vitrohm 103-6
R23	470	Composition	1/3	10	919187	Vitrohm 103-6
R24	470	Composition	1/3	10	919187	Vitrohm 103-6
R25	470	Composition	1/3	10	919187	Vitrohm 103-6
R26	470	Composition	1/3	10	919187	Vitrohm 103-6
R27	1k	Composition	1/3	10	918075	Vitrohm 103-6
R28	470	Composition	1/3	10	919187	Vitrohm 103-6
R29	150	Composition	1/3	10	919189	Vitrohm 103-6
R30	10	Composition	1/3	10	919173	Vitrohm 103-6
R31	470	Composition	1/3	10	919187	Vitrohm 103-6
R32	22k	Composition	1/3	10	918074	Vitrohm 103-6
R33	22k	Composition	1/3	10	918074	Vitrohm 103-6
R34	10	Composition	1/3	10	919173	Vitrohm 103-6
R35	2.2k	Composition	1/3	10	919169	Vitrohm 103-6

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Resistors (Contd.)				
R36	10	Composition	1/3	10	919173	Vitrohm 103-6
R37	10	Composition	1/3	10	919173	Vitrohm 103-6
R38	47	Composition	1/3	10	919622	Vitrohm 103-6
R39	10	Composition	1/3	10	919173	Vitrohm 103-6
R40	4.7k	Composition	1/3	10	919165	Vitrohm 103-6
R41	10	Composition	1/3	10	919173	Vitrohm 103-6
R42	4.7k	Composition	1/3	10	919165	Vitrohm 103-6
R43	2.2k	Composition	1/3	10	919169	Vitrohm 103-6
R44	10	Composition	1/3	10	919173	Vitrohm 103-6
R45	220	Composition	1/3	10	919174	Vitrohm 103-6
R46	220	Composition	1/3	10	919174	Vitrohm 103-6
R47	10k	Composition	1/3	10	918073	Vitrohm 103-6
R48	4.7k	Composition	1/3	10	919165	Vitrohm 103-6
R49	3.3k	Composition	1/3	10	919168	Vitrohm 103-6
R50	220	Composition	1/3	10	919174	Vitrohm 103-6
R51	220	Composition	1/3	10	919174	Vitrohm 103-6
R52	2.2k	Composition	1/3	10	919169	Vitrohm 103-6
R53	560	Composition	1/3	10	919164	Vitrohm 103-6
R54	10	Composition	1/3	10	919173	Vitrohm 103-6
		Capacitors				
C1	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V
C2	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V
C3	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V
C4	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V
C5	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V
C6	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V
C7	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V
C8	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V
C9	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V
C10	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V

Cct. Ref.	Value	Description	Rat	Tal %	Racal Part Number	Manufacturer
		Capacitors (Contd.)				
C11	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V
C12	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V
C13	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V
C14	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V
C15	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V
C16	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V
C17	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V
C18	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V
C19	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V
C20	10p	Ceramic		10	914912	Erie 831/NPO
C21	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V
C22	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V
C23	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V
C24	10p	Ceramic		10	914912	Erie 831/NPO
C25	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V
C26	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V
C27	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V
C28	6.8	Tantalum	35V	20	921179	Union Carbide K6R 8E35
C29	.0033	Polystyrene	30V	2	921259	Suflex EP9 30V
C30	.0033	Polystyrene	30V	2	921259	Suflex EP9 30V



Cct. Ref.	Value	Description	Rat	Tal %	Racal Part Number	Manufacturer
		Capacitors (Contd.)				
C31	.0033	Palystyrene	30V	2	921259	Suflex EP9 30V
C32	.0033	Palystyrene	30V	2	921259	Suflex EP9 30V
C33	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V
C34	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V
C35	0.1	Palycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C36	.0022	Palystyrene	30V	2	921261	Suflex EP9
C37	150	Tantalum	10V	+50 -20	921531	Mullard 016 15151
C38	.0047	Polystyrene	30	2	921262	Suflex EP9
C39	.0022	Polystyrene	30	2	921261	Suflex EP9
C40	33	Tantalum	10V	20	921224	Unian Carbide K33E10
C41	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V
C42	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V
C43	100p	Ceramic	500V	10	917417	Erie 831/N3300
C44	.033	Ceramic	18V	+50 -20	918833	Erie 831/T/18V
C45	.033	Ceramic	18V	+50 -20	918833	Erie 831/T/18V
C46	.001	Polystyrene	30V	2	921260	Suflex EP9
C47	.001	Polystyrene	30V	2	921260	Suflex EP9
C48	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V
C49	6.8	Tantalum	35V	20	921179	Union Carbide K6R8E35
C50	.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V
C51	1	Palycarbonate	100	20	915370	STC PMC 2R/1.0/M100
C52	.001	Ceramic	500	20	915243	Erie Hi-K831/K2600
C53	100p	Ceramic	500	10	917417	Erie 831/N3300
C54	0.033	Ceramic	18V	+50 -20	911883	Erie 831/T/18V



Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Inductors				
L1	220	Choke		5	918986	Delevan 1537/92
L2	220	Choke		5	918986	Delevan 1537/92
L3	220	Choke		5	918986	Delevan 1537/92
L4	220	Choke		5	918986	Delevan 1537/92
L5	220	Choke		5	918986	Delevan 1537/92
L6	220	Choke		5	918986	Delevan 1537/92
L7	220	Choke		5	918986	Delevan 1537/92
L8	220	Choke		5	918986	Delevan 1537/92
L9	15	Choke		10	915850	Delevan 1537/40
L10	15	Chake		10	915850	Delevan 1537/40
L11	1mH	Choke		10	915849	Delevan 1537/12
L12	1mH	Choke		10	915849	Delevan 1537/12
L13	15	Chake		10	915850	Delevan 1537/40
L14	1mH	Choke		10	915849	Delevan 1537/12
L15	5.6	Choke		10	922275	Delevan 1537/28
		Transistors				
TR1		Silicon n-p-n			906842	ITT 2N2369
TR2		Silicon n-p-n			906842	ITT 2N2369
TR3		Silicon n-p-n			906842	ITT 2N2369
TR4		Silicon n-p-n			906842	ITT 2N2369
TR5		Silicon n-p-n			906842	ITT 2N2369
TR6		Silicon n-p-n			914900	Mullard BC109
TR7		Silicon n-p-n			906842	ITT 2N2369
TR8		Silicon n-p-n			914900	Mullard BC109
TR9		Silicon n-p-n			915231	S.G.S. BFX48
TR10		Silicon n-p-n			906842	ITT 2N2369
		Diodes				
D1		Silicon			914898	Mullard 1N4149
D2		Silicon			914898	Mullard 1N4149
D3		Silicon			914898	Mullard 1N4149
D4	12V	Zener			914310	Mullard BZY88C12

Cct. Ref.	Value	Description	Rat	Tal %	Racal Part Number	Manufacturer
		Integrated Circuits				
ML1		Decade Divider			920333	Signetics N8290A
ML2		Decade Divider			920333	Signetics N8290A
ML3		Mixer			919747	Fairchild U5E 7796393
ML4		Quad 2 input Nand gate			918366	ITT MIC 7400J
ML5		8 input Nand gate			919492	ITT MIC 7430J
ML6		Dual D Flip Flop			917509	ITT 7474J
ML7		Dual 4 input Schmitt			921278	ITT 7413J
ML8		Dual D Flip Flop			917509	ITT 7474J
ML9		Monastable			921258	ITT 74121J
ML10		Manastable			921258	ITT 74121J
ML11		Dual D Flip Flop			917509	ITT 7474J
		Ferrite Beads				
FB1					907488	Mullard FX1242
FB2					907488	Mullard FX1242

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		RTTY GENERATOR BOARD PM340 FIG.13				
		Resistors				
R1	22k	Composition	1/3	10	918074	Dubilier BT103-6
R2	4.7k	Composition	1/3	10	919165	Dubilier 8T103-6
R3	3.3k	Composition	1/3	10	919168	Dubilier 8T103-6
R4	100	Composition	1/3	10	918076	Dubilier 8T103-6
R5	2.2k	Composition	1/3	10	919169	Dubilier BT103-6
R6	39k	Composition	1/3	10	919623	Dubilier 8T103-6
R7	6.8k	Composition	1/3	10	919192	Dubilier 8T103-6
R8	2.2k	Composition	1/3	10	919169	Dubilier BT103-6
R9	39k	Compasition	1/3	10	919623	Dubilier 8T103-6
R10	6.8k	Compasition	1/3	10	919192	Dubilier BT103-6
R11	2.2k	Composition	1/3	10	919169	Dubilier 8T103-6
R12	100k	Campositian	1/3	10	919163	Dubilier 8T103-6
R13	18k	Composition	1/3	10	919621	Dubilier 8T103-6
R14	15k	Compasitian	1/3	10	918078	Dubilier 8T103-6
R15	100k	Variable			916411	Morganite Type 80
R16	5.6k	Metal Oxide		5	921479	Electrosil TR4
R17	3.9k	Metal Oxide		5	900990	Electrosil TR4
R18	1.2k	Metal Oxide		5	908285	Electrosil TR4
R19	2.7k	Metal Oxide		5	908294	Electrosil TR4
R20	68k	Metal Oxide		5	908279	Electrosil TR4
R21	33	Metal Oxide		5	908690	Electrosil TR4
R22	10k	Variable			921480	Morganite Pot 85w
R23	33k	Metal Oxide		5	908291	Electrosil TR4
R24	3.3k	Compasition	1/3	5	919168	Dubilier BT103-6
R25	1.8k	Compasitian	1/3	5	919177	Dubilier BT103-6
R26	1k	Compasitian	1/3	5	918075	Dubilier BT103-6
R27	820	Compasitian	1/3	5	919112	Dubilier BT103-6
R28	10	Compasition	1/3	10	919173	Dubilier BT103-6
R29	120	Metal Oxide		5	920850	Electrosil TR4
R30	56k	Composition	1/3	10	919183	Dubilier BT103-6
R31	5k	Variable			921[illegible]28	Daystrom 567-00H[illegible]

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Capacitors				
C1	0.1	Polycarbonate	100		914173	ITT PMC2R/0.1/M100
C2	4.7	Electrolytic	35V		914026	Kemet K4R7E35
C3	4700p	Polystyrene			921262	Suflex EP9
C4	4700p	Silver Mica			902209	Lemco
C5	330p	Ceramic	100V		921471	Erie 8121MU2J
C6	0.1	Polycarbonate			914173	ITT PMC2R/0.1/M100
C7	22	Electrolytic	16V		920263	Kemet K22E16
C8	330p	Ceramic			921472	Erie 831
C9	4.7	Electralytic	35V		914026	Kemet K4R7E35
		Transistors				
TR1		Silicon			914907	Texas 2N4392
TR2		Silicon n-p-n			906842	Mullard 2N2369
TR3		Silicon n-p-n			906842	Mullard 2N2369
TR4		Silicon n-p-n			914900	Mullard BC109
TR5		Silicon p-n-p			915231	S.G.S. BFX48
TR6		Silicon p-n-p			915231	S.G.S. BFX48
TR7		Silicon n-p-n			914900	Mullard BC109
TR8		Silicon p-n-p			915231	S.G.S. BFX48
TR9		Silicon n-p-n			914900	Mullard BC109
TR10		Silicon n-p-n			906842	Mullard 2N2369
TR11		Silicon n-p-n			921473	Jermyn D5K2
		Diodes				
D1	4.7V	Zener			914067	Mullard BZY88C4V7
D2	3.3V	Zener			912567	Mullard BZY88C3V3
D3					914898	ITT 1N4149
D4					914898	ITT 1N4149
D5					914898	ITT 1N4149
D6					914898	ITT 1N4149
D7					914898	ITT 1N4149
D8					914898	ITT 1N4149
D9					914898	ITT 1N4149
D10					914898	ITT 1N4149
D11	4.7V	Zener			914067	Mullard BZY88C4V7
		Integrated Circuit				
ML1		J-K Flip Flop			921475	Mullard 7470J

Cct. Ref.	Value	Description	Rat	Tol %	Racol Part Number	Manufacturer
		LOW LEVEL BOARD PM341 FIG.11				
		Resistors				
R1	1.8k	Composition	1/3	10	919177	Dubilier BT103-6
R2	220	Composition	1/3	10	919174	Dubilier BT103-6
R3	680	Composition	1/3	10	919191	Dubilier BT103-6
R4	220	Composition	1/3	10	919174	Dubilier BT103-6
R5	680	Composition	1/3	10	919191	Dubilier BT103-6
R6	560	Composition	1/3	10	919164	Dubilier BT103-6
R7	3.3k	Composition	1/3	10	919168	Dubilier BT103-6
R8	560	Composition	1/3	10	919164	Dubilier BT103-6
R9	3.3k	Composition	1/3	10	919168	Dubilier BT103-6
R10	820	Composition	1/3	10	919112	Dubilier BT103-6
R11	270	Composition	1/3	10	918077	Dubilier BT103-6
R12	820	Composition	1/3	10	919112	Dubilier BT103-6
R13	270	Composition	1/3	10	918077	Dubilier BT103-6
R14	68	Composition	1/3	10	919186	Dubilier BT103-6
R15	68	Composition	1/3	10	919186	Dubilier BT103-6
R16	22	Composition	1/3	10	919193	Dubilier BT103-6
R17	22	Composition	1/3	10	919193	Dubilier BT103-6
R18	22k	Composition	1/3	10	918074	Dubilier BT103-6
R19	10k	Composition	1/3	10	918073	Dubilier BT103-6
R20	10k	Composition	1/3	10	918073	Dubilier BT103-6
R21	3.3k	Composition	1/3	10	91916B	Dubilier BT103-6
R22	10k	Composition	1/3	10	918073	Dubilier BT103-6
R23	10k	Composition	1/3	10	918073	Dubilier BT103-6
R24	3.3k	Composition	1/3	10	919168	Dubilier BT103-6
R25	15k	Composition	1/3	10	918078	Dubilier BT103-6
R26	39k	Composition	1/3	10	919623	Dubilier BT103-6
R27	39k	Composition	1/3	10	919623	Dubilier BT103-6
R28	39k	Composition	1/3	10	919623	Dubilier BT103-6
R29	39k	Composition	1/3	10	919623	Dubilier BT103-6
R30	220	Composition	1/3	10	919174	Dubilier BT103-6
R31	1.8k	Composition	1/3	10	919177	Dubilier BT103-6
R32	27k	Composition	1/3	10	918707	Dubilier BT103-6
R33	680k	Composition	1/3	10	920853	Dubilier BT103-6
R34	27k	Composition	1/3	10	918707	Dubilier BT103-6
R35	680k	Composition	1/3	10	920853	Dubilier BT103-6

Cct. Ref.	Volue	Description	Rot	Tol %	Racal Part Number	Manufacturer
		Resistors (Contd.)				
R36	2.2k	Composition	1/3	10	919169	Dubilier BT103-6
R37	1k	Composition	1/3	10	918075	Dubilier 8T103-6
R38	1.2k	Composition	1/3	10	919172	Dubilier BT103-6
R39	1.2k	Composition	1/3	10	919172	Dubilier 8T103-6
R40	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R41	56k	Composition	1/3	10	919183	Dubilier 8T103-6
R42	1.2k	Composition	1/3	10	919172	Dubilier BT103-6
R43	22k	Composition	1/3	10	918074	Dubilier 8T103-6
R44	56k	Composition	1/3	10	919183	Dubilier BT103-6
R45	1.2k	Composition	1/3	10	919172	Dubilier BT103-6
R46	22k	Composition	1/3	10	918074	Dubilier 8T103-6
R47	470	Composition	1/3	10	919187	Dubilier 8T103-6
R48	27k	Composition	1/3	10	918707	Dubilier 8T103-6
R49	27k	Composition	1/3	10	918707	Dubilier BT103-6
R50	1k	Composition	1/3	10	918075	Dubilier 8T103-6
R51	1M	Composition	1/3	10	920855	Dubilier 8T103-6
R52	100	Composition	1/3	10	918076	Dubilier BT103-6
R53	100	Composition	1/3	10	918076	Dubilier 8T103-6
R54	6.8k	Composition	1/3	10	919192	Dubilier 8T103-6
R55	18k	Composition	1/3	10	919621	Dubilier BT103-6
R56	1k	Composition	1/3	10	918075	Dubilier 8T103-6
R57	470	Composition	1/3	10	919187	Dubilier 8T103-6
R58	470	Composition	1/3	10	919187	Dubilier BT103-6
R59	10k	Composition	1/3	10	918073	Dubilier BT103-6
R60	10k	Composition	1/3	10	918073	Dubilier BT103-6
R61	10k	Composition	1/3	10	918073	Dubilier BT103-6
R62	10k	Composition	1/3	10	918073	Dubilier BT103-6
R63	10k	Composition	1/3	10	918073	Dubilier BT103-6
R64	12k	Composition	1/3	10	919190	Dubilier BT103-6
R66	2.7M	Composition	1/3	10	920860	Dubilier BT103-6
R67	2.7M	Composition	1/3	10	920860	Dubilier BT103-6
R68	560	Composition	1/3	10	919164	Dubilier BT103-6
R70	4.7k	Composition	1/3	10	919165	Dubilier 8T103-6

Cct. Ref.	Value	Description	Rat	Tol %	Rocal Part Number	Manufacturer
		Resistors (Contd.)				
R71	2.7k	Composition	1/3	10	919170	Dubilier BT103-6
R72	1k	Composition	1/3	10	918075	Dubilier BT103-6
R74	1k	Composition	1/3	10	918075	Dubilier BT103-6
R76	3.3k	Composition	1/3	10	919168	Dubilier BT103-6
R77	1.8k	Composition	1/3	10	919177	Dubilier BT103-6
R78	10k	Composition	1/3	10	918073	Dubilier BT103-6
R80	10k	Composition	1/3	10	918073	Dubilier BT103-6
R81	10k	Composition	1/3	10	918073	Dubilier BT103-6
RB2	27k	Composition	1/3	10	918707	Dubilier BT103-6
R83	1Bk	Composition	1/3	10	91B621	Dubilier BT103-6
R84	12	Composition	1/3	10	919977	Dubilier BT103-6
RB5	39k	Composition	1/3	10	919623	Dubilier BT103-6
R86	27k	Composition	1/3	10	918707	Dubilier BT103-6
R87	2.2k	Composition	1/3	10	919169	Dubilier BT103-6
R88	1k	Composition	1/3	10	918075	Dubilier BT103-6
R89	1k	Composition	1/3	10	918075	Dubilier BT103-6
R90	560	Composition	1/3	10	919164	Dubilier BT103-6
R91	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R92	3.3k	Composition	1/3	10	919168	Dubilier BT103-6
R93	10k	Composition	1/3	10	918073	Dubilier BT103-6
R94	6.8k	Composition	1/3	10	919192	Dubilier BT103-6
R95	6.8k	Metal Oxide		2	910112	Electrosil TR4
R96	2.2k	Composition	1/3	10	919169	Dubilier BT103-6
R97	1.8k	Composition	1/3	10	919177	Dubilier BT103-6
R98	1.Bk	Composition	1/3	10	919177	Dubilier BT103-6
R99	1k	Composition	1/3	10	91B075	Dubilier BT103-6
R100	2.2k	Composition	1/3	10	919169	Dubilier BT103-6
R101	6.Bk	Metol Oxide		2	910112	Electrosil TR4
R102	12k	Composition	1/3	10	919190	Dubilier BT103-6
R103	15k	Composition	1/3	10	91B078	Dubilier BT103-6
R104	18k	Composition	1/3	10	900994	Dubilier BT103-6
R105	2.7k	Composition	1/3	10	916548	Dubilier BT103-6
R106	220	Composition	1/3	10	919174	Dubilier BT103-6
R107	2.2k	Composition	1/3	10	919169	Dubilier BT103-6
R108	6.8k	Metal Oxide		2	910112	Electrosil TR4

Cct. Ref.	Value	Description	Rat	Tal %	Racal Part Number	Manufacturer
		Resistors (Contd.)				
R109	1Bk	Metal Oxide		2	900994	Electrosil TR4
R110	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R111	560	Composition	1/3	10	919164	Dubilier BT103-6
R112	6.Bk	Metal Oxide		2	910112	Electrosil TR4
R113	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R114	10k	Composition	1/3	10	91B073	Dubilier BT103-6
R115	10k	Composition	1/3	10	91B073	Dubilier BT103-6
R116	10k	Composition	1/3	10	91B073	Dubilier BT103-6
R117	10k	Composition	1/3	10	91B073	Dubilier BT103-6
R11B	1Bk	Composition	1/3	10	919621	Dubilier BT103-6
R119	12	Composition	1/3	10	919977	Dubilier BT103-6
R120	47k	Composition	1/3	10	9191BB	Dubilier BT103-6
R121	22k	Composition	1/3	10	91B074	Dubilier 8T103-6
R122	22k	Composition	1/3	10	91B074	Dubilier BT103-6
R123	22k	Composition	1/3	10	918074	Dubilier BT103-6
R124	1k	Composition	1/3	10	91B075	Dubilier BT103-6
R125	560	Composition	1/3	10	919164	Dubilier 8T103-6
R126	47k	Composition	1/3	10	919188	Dubilier 8T103-6
R127	22k	Composition	1/3	10	91B074	Dubilier BT103-6
R128	1k	Composition	1/3	10	918075	Dubilier 8T103-6
R129	220	Composition	1/3	10	919174	Dubilier BT103-6
R130	1k	Composition	1/3	10	918075	Dubilier BT103-6
R131	220	Composition	1/3	10	919174	Dubilier BT103-6
R132	2.2k	Composition	1/3	10	919169	Dubilier BT103-6
R133	6.8k	Composition	1/3	10	919192	Dubilier BT103-6
R134	56	Composition	1/3	10	9191B5	Dubilier BT103-6
R135	220	Composition	1/3	10	919174	Dubilier BT103-6
R136	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R137	2.2k	Composition	1/3	10	919169	Dubilier BT103-6
R13B	220	Composition	1/3	10	919174	Dubilier BT103-6
R139	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R140	2.2k	Composition	1/3	10	919169	Dubilier BT103-6
R141	1B0	Composition	1/3	10	919175	Dubilier BT103-6
R142	1B0	Composition	1/3	10	919175	Dubilier BT103-6
R143	6.Bk	Composition	1/3	10	919192	Dubilier BT103-6

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Resistors (Contd.)				
R144	47	Composition	1/3	10	919622	Dubilier 8T103-6
R145	18k	Composition	1/3	10	919621	Dubilier 8T103-6
R146	470	Composition	1/3	10	919187	Dubilier 8T103-6
R147	82	Composition	1/3	10	919817	Dubilier 8T103-6
R148	56	Composition	1/3	10	919185	Dubilier 8T103-6
R150	1k	Composition	1/3	10	918075	Dubilier 8T103-6
R151	180	Composition	1/3	10	919175	Dubilier 8T103-6
R152	56	Composition	1/3	10	919185	Dubilier 8T103-6
R153	56	Composition	1/3	10	919185	Dubilier BT103-6
R154	10k	Composition	1/3	10	918073	Dubilier 8T103-6
R155	6.8k	Composition	1/3	10	919192	Dubilier 8T103-6
R156	1.8k	Composition	1/3	10	919177	Dubilier 8T103-6
R157	6.8k	Composition	1/3	10	919192	Dubilier 8T103-6
R158	1.8k	Composition	1/3	10	919177	Dubilier 8T103-6
R159	2.2k	Composition	1/3	10	919169	Dubilier 8T103-6
R160	47	Composition	1/3	10	919622	Dubilier 8T103-6
R161	1k	Composition	1/3	10	918075	Dubilier BT103-6
R162	560	Composition	1/3	10	919164	Dubilier 8T103-6
R163	47	Composition	1/3	10	919622	Dubilier 8T103-6
R164	1k	Composition	1/3	10	918075	Dubilier 8T103-6
R165	560	Composition	1/3	10	919164	Dubilier 8T103-6
R166	10k	Composition	1/3	10	918073	Dubilier BT103-6
R167	4.7k	Composition	1/3	10	919165	Dubilier 8T103-6
R168	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R169	8.2k	Composition	1/3	10	919182	Dubilier BT103-6
R170	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R171	180	Composition	1/3	10	919175	Dubilier BT103-6
R172	2.2k	Composition	1/3	10	919169	Dubilier BT103-6
R173	3.3k	Composition	1/3	10	919168	Dubilier BT103-6
R174	3.3k	Composition	1/3	10	919168	Dubilier BT103-6
R177	10k	Composition	1/3	10	918073	Dubilier BT103-6
R178	10	Composition	1/3	10	919173	Dubilier 8T103-6
R179	1.5k	Composition	1/3	10	919180	Dubilier BT103-6
R180	1.5k	Composition	1/3	10	919180	Dubilier 8T103-6
R181	10	Composition	1/3	10	919173	Dubilier 8T103-6

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Resistors (Contd.)				
R182	1k	Metal Oxide		2	913489	Electrosil TR4
R183	2.7k	Composition	1/3	10	919170	Dubilier BT103-6
R185	1k	Metal Oxide		2	913489	Electrosil TR4
R186	2.2k	Composition	1/3	10	919169	Dubilier BT103-6
R187	1k	Composition	1/3	10	918075	Dubilier BT103-6
R188	18	Metal Oxide		2	916545	Electrosil TR4
R189	390	Metal Oxide		2	916331	Electrosil TR4
R191	820	Composition	1/3	10	919112	Dubilier BT103-6
R192	2.2k	Composition	1/3	10	919169	Dubilier BT103-6
R193	1.8k	Composition	1/3	10	919177	Dubilier BT103-6
R194	2.2k	Composition	1/3	10	919169	Dubilier BT103-6
R196	470	Composition	1/3	10	919187	Dubilier BT103-6
R197	180	Composition	1/3	10	919175	Dubilier BT103-6
R198	82	Composition	1/3	10	919817	Dubilier BT103-6
R199	1.8k	Composition	1/3	10	919177	Dubilier BT103-6
R200	1.8k	Composition	1/3	10	919177	Dubilier BT103-6
R201	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R202	10k	Composition	1/3	10	918073	Dubilier BT103-6
R203	47k	Composition	1/3	10	919188	Dubilier BT103-6
R205	75	Metal Oxide		2	908288	Electrosil TR4
R206	47k	Composition	1/3	10	919188	Dubilier BT103-6
R207	68	Composition	1/3	10	919186	Dubilier BT103-6
R208	1.8k	Composition	1/3	10	919177	Dubilier BT103-6
R209	10k	Composition	1/3	10	918073	Dubilier BT103-6
R210	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R211	1.8k	Composition	1/3	10	919177	Dubilier BT103-6
R212	47k	Composition	1/3	10	919188	Dubilier BT103-6
R213	3.3k	Composition	1/3	10	919168	Dubilier BT103-6
R214	820	Composition	1/3	10	919112	Dubilier BT103-6
R215	10k	Composition	1/3	10	918073	Dubilier BT103-6
R216	3.3k	Composition	1/3	10	919168	Dubilier BT103-6
R217	3.9k	Composition	1/3	10	919166	Dubilier BT103-6
R218	680	Composition	1/3	10	919191	Dubilier BT103-6
R219	47	Composition	1/3	10	919622	Dubilier BT103-6
R220	3.3k	Composition	1/3	10	919168	Dubilier BT103-6

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Resistors (Contd.)				
R221	560	Composition	1/3	10	919164	Dubilier BT103-6
R222	3.3k	Composition	1/3	10	919168	Dubilier BT103-6
R223	10k	Composition	1/3	10	918073	Dubilier BT103-6
R224	10k	Composition	1/3	10	918073	Dubilier BT103-6
R225	10k	Compasition	1/3	10	918073	Dubilier BT103-6
R226	10k	Composition	1/3	10	918073	Dubilier BT103-6
R227	4.7k	Compasition	1/3	10	919165	Dubilier BT103-6
R228	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R229	100k	Camposition	1/3	10	919163	Dubilier BT103-6
R230	100k	Composition	1/3	10	919163	Dubilier BT103-6
		Potentiometers				
R65	2k	Linear			921467	Daystrom 567-00HS
R69	2k	Linear			921467	Daystrom 567-00HS
R73	200	Linear			921482	Daystrom 567-00HS
R75	200	Linear			921482	Daystrom 567-00HS
R79	50k	Linear			921376	Daystrom 567-00HS
R149	2k	Linear			921467	Daystrom 567-00HS
R175	1k	Linear			921478	Daystrom 567-00HS
R176	1k	Linear			921478	Daystrom 567-00HS
R184	2k	Linear			921467	Daystrom 567-00HS
R190	5k	Linear			921328	Daystrom 567-00HS
R195	50k	Linear			921376	Daystrom 567-00HS
R204	2k	Linear			922246	Morganite 85W
		Capacitors				
C1	22	Electrolytic	16V	20	920263	Kemet K22E16
C2	22	Electrolytic	16V	20	920263	Kemet K22E16
C3	22	Electrolytic	16V	20	920263	Kemet K22E16
C4	22	Electrolytic	16V	20	929263	Kemet K22E16
C5	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M1
C6	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M1
C7	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M1
C8	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M1
C9	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M1
C10	22	Electrolytic	16V	20	920263	Kemet K22E16

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Capacitors				
C11	22	Electralytic	16V	20	920263	Kemet K22E16
C12	0.1	Palycarbonote	100V	20	914173	STC PMC 2R/0.1/M100
C13	22	Electrolytic	16V	20	920263	Kemet K22E16
C14	47	Electrolytic	16V	20	915100	Kemet K47E16
C15	22	Electrolytic	16V	20	920263	Kemet K22E16
C16	47	Electrolytic	16V	20	915100	Kemet K47E16
C17	47	Electrolytic	16V	20	915100	Kemet K47E16
C18	22	Electralytic	16V	20	920263	Kemet K22E16
C19	47	Electrolytic	16V	20	915100	Kemet K47E16
C20	4.7	Electrolytic	35V	20	914026	Kemet K4R7E35
C21	4.7	Electrolytic	35V	20	914026	Kemet K4R7E35
C22	2.2p	Ceramic	500V	$\pm\frac{1}{2}$p	917734	Erie 831 P100
C23	2.2p	Ceromic	500V	$\pm\frac{1}{2}$p	917734	Erie 831 P100
C24	22	Electrolytic	16V	20	920263	Kemet K22E16
C25	22	Electralytic	16V	20	920263	Kemet K22E16
C26	220p	Ceramic	500V	10	914916	Erie 831 N4200
C27	22	Electrolytic	16V	20	920263	Kemet K22E16
C28	22	Electrolytic	16V	20	920263	Kemet K22E16
C29	0.1	Polycorbonate	100V	20	914173	STC PMC 2R/0.1/M100
C30	22	Electrolytic	16V	20	920263	Kemet K22E16
C31	22	Electrolytic	16V	20	920263	Kemet K22E16
C32	.01	Polycarbonate	100V	20	922291	STC PMC2R/0.01/M100
C33	.01	Polycorbonote	100V	20	922291	STC PMC2R/0.01/M100
C34	4.7	Electrolytic	35V	20	914026	Kemet K4R7E35
C35	4.7	Electrolytic	35V	20	914026	Kemet K4R7E35
C36	1.0	Polyester	63V	5	918702	Wima MKS 63V
C37	0.1	Polycorbonote	100V	20	914173	STC PMC 2R/0.1/M100
C38	22	Electrolytic	16V	20	920263	Kemet K22E16
C39	0.1	Polycarbonote	100V	20	914173	STC PMC 2R/0.1/M100
C40	32	Electrolytic	16V	-10+50	915839	Mullord C428 AR/E32
C41	4.7	Electrolytic	35V	20	914026	Kemet K4R7E35
C42	0.1	Polycarbonote	100V	20	914173	STC PMC 2R/0.1/M100
C43	0.1	Polycarbonote	100V	20	914173	STC PMC 2R/0.1/M100
C44	4.7	Electrolytic	35V	20	914026	Kemet K4R7E35
C45	0.1	Polycarbonote	100V	20	914173	STC PMC 2R/0.1/M100

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Capacitors (Contd.)				
C46	22	Electrolytic	16V	20	920263	Kemet K22E16
C47	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C48	0.1	Palycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C49	22	Electrolytic	16V	20	920263	Kemet K22E16
C50	32	Electrolytic	16V	-10+50	915839	Mullard C428 AR/E32
C51	4.7	Electralytic	35V	20	914026	Kemet K4R7 E35
C52	22	Electralytic	16V	20	920263	Kemet K22E16
C53	4.7	Electralytic	35V	20	914026	Kemet K4R7 E35
C54	22	Electralytic	16V	20	920263	Kemet K22E16
C55	0.1	Polycarbonate	100V	20	919173	STC PMC 2R/0.1/M100
C56	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C57	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C58	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C59	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C60	22	Electrolytic	16V	20	920263	Kemet K22E16
C61	22	Electrolytic	16V	20	920263	Kemet K22E16
C62	0.1	Polycorbonate	100V	20	914173	STC PMC 2R/0.1/M100
C63	0.01	Ceramic	25V	-25+50	911845	Erie 831/T/25V
C64	0.1	Polycorbonate	100V	20	914173	STC PMC 2R/0.1/M100
C65	0.1	Polycorbonate	100V	20	914173	STC PMC 2R/0.1/M100
C66	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C67	4.7	Electrolytic	35V	20	914026	Kemet K4R7 E35
C68	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C69	22	Electrolytic	16V	20	920263	Kemet K22E16
C70	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C71	0.1	Polycarbanate	100V	20	914173	STC PMC 2R/0.1/M100
C72	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C73	0.1	Polycorbonate	100V	20	914173	STC PMC 2R/0.1/M100
C74	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C75	0.1	Polycorbonate	100V	20	914173	STC PMC 2R/0.1/M100
C76	0.1	Polycorbonate	100V	20	914173	STC PMC 2R/0.1/M100
C77	0.01	Ceramic	25V	-25+50	911845	Erie 831/T/25V
C78	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C79	4.7	Electrolytic	35V	20	914026	Kemet K4R7E35
C80	.01	Ceramic	25V	-25+50	911845	Erie 831/T/25V

Cct. Ref.	Value	Description	Rat	Tal %	Racal Part Number	Manufacturer
		Capacitors (Contd.)				
C81	.01	Ceramic	25V	-25+50	911845	Erie 831/T/25V
C82	.01	Ceramic	25V	-25+50	911845	Erie 831/T/25V
C83	.01	Ceramic	25V	-25+50	911845	Erie 831/T/25V
C84	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C85	4.7	Electrolytic	35V	20	914026	Kemet K4R7 E35
C86	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C87	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C88	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C89	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C90	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C91	150p	Polystyrene	30V	2	921068	Suflex EP9
C92	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C93	470	Ceramic	500V	10	917453	Erie 831 K170051
C94	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C95	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C96	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C97	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C98	22	Electrolytic	16V	20	920263	Kemet K22E16
C99	22	Electrolytic	16V	20	920263	Kemet K22E16
C100	22	Electrolytic	16V	20	920263	Kemet K22E16
C101	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C102	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C103	0.01	Ceramic	25V	-25+50	911845	Erie 831/T/25V
		Transformers				
T1					CT603480	Racal
T2					CT603481	Racal
T3					CT603481	Racal
T4					CT603482	Racal
T5					CT603482	Racal
T6					CT603483	Racal
		Transistors				
TR1		Silicon n-p-n			906842	ITT 2N2369
TR2		Silicon p-n-p			915231	SGS BFX48
TR3		Silicon n-p-n			906842	ITT 2N2369
TR4		Silicon p-n-p			915231	SGS BFX48
TR5		Silicon n-p-n			906842	ITT 2N2369

Cct. Ref.	Value	Description	Rot	Tol %	Rocal Part Number	Manufacturer
		Transistors (Contd.)				
TR6		Silicon n-p-n			914900	Mullard BC109
TR7		Silicon n-p-n			914900	Mullard BC109
TR8		Silicon n-p-n			906842	ITT 2N2369
TR9		Silicon n-p-n			906842	ITT 2N2369
TR10		Silicon n-p-n			914900	Mullard BC109
TR11		Silicon n-p-n			914900	Mullard BC109
TR12		Silicon n-p-n			914900	Mullard BC109
TR13		Silicon n-p-n			914900	Mullard BC109
TR14		Silicon n-p-n			915231	SGS 8FX48
TR15		Silicon n-p-n			906842	ITT 2N2369
TR16		Silicon n-p-n			914900	Mullard BC109
TR17		Silicon n-p-n			914900	Mullard BC109
TR18		F.E.T.			916946	Mullard 8FW10
TR19		Silicon n-p-n			906842	ITT 2N2369
TR20		Silicon n-p-n			906842	ITT 2N2369
TR21		Silicon n-p-n			906842	ITT 2N2369
TR22		Silicon n-p-n			908753	Mullard 8FY51
TR23		Silicon n-p-n			906842	ITT 2N2369
TR24		Silicon n-p-n			906842	ITT 2N2369
TR25		Silicon n-p-n			906842	ITT 2N2369
TR26		Silicon n-p-n			906842	ITT 2N2369
TR27		Silicon n-p-n			906842	ITT 2N2369
TR28		Silicon n-p-n			906842	ITT 2N2369
TR29		Silicon n-p-n			906842	ITT 2N2369
TR30		Silicon n-p-n			906842	ITT 2N2369
TR31		Silicon n-p-n			906842	ITT 2N2369
TR32		Silicon n-p-n			906842	ITT 2N2369
TR33		Silicon n-p-n			908753	Mullard BCY51
TR34		Silicon n-p-n			914900	Mullard BC109
TR35		Silicon n-p-n			914900	Mullard BC109
TR36		Silicon n-p-n			906842	ITT 2N2369
TR37		Silicon n-p-n			914900	Mullard BC109
TR38		Silicon n-p-n			914900	Mullard BC109
TR39		Silicon n-p-n			906842	ITT 2N2369
TR40		Silicon n-p-n			906842	ITT 2N2369

Cct. Ref.	Value	Description	Rot	Tal %	Racal Part Number	Manufacturer
		Transistors (Cantd.)				
TR41		Silicon n-p-n			906842	ITT 2N2369
TR42		Silicon n-p-n			906842	ITT 2N2369
TR43		Silicon n-p-n			906842	ITT 2N2369
TR44		Silicon n-p-n			906842	ITT 2N2369
TR45		Silicon n-p-n			916627	Mullard BFX89
TR46		Silicon p-n-p			915231	SGS BFX48
TR47		Silicon n-p-n			906842	ITT 2N2369
TR48		Silicon n-p-n			906842	ITT 2N2369
TR49		Silicon n-p-n			906842	ITT 2N2369
TR50		Silicon n-p-n			906842	ITT 2N2369
TR51		Dual n-p-n			917077	SGS 2C444
TR52		Silicon n-p-n			906842	ITT 2N2369
TR53		Silicon n-p-n			914900	Mullard BC109
TR54		Silicon n-p-n			914900	Mullard BC109
TR55		Silicon n-p-n			906842	ITT 2N2369
TR56		Silicon n-p-n			906842	ITT 2N2369
TR57		Silicon n-p-n			906842	ITT 2N2369
TR58		Silicon n-p-n			906842	ITT 2N2369
TR59		Silicon n-p-n			906842	ITT 2N2369
TR60		Silicon n-p-n			914900	Mullard BC109
TR61		Silicon n-p-n			906842	ITT 2N2369
TR62		Silicon n-p-n			906842	ITT 2N2369
TR63		Silicon n-p-n			906842	ITT 2N2369
TR64		Silicon n-p-n			906842	ITT 2N2369
		Diodes				
D1	4.7V	Zener			914067	Mullard BZY88 C4V7
D2					914898	STC 1N4149
D3					914898	STC 1N4149
D4					914898	STC 1N4149
D5	15V	Zener			919797	Mullard BZY88 C15
D6	15V	Zener			919797	Mullard BZY88 C15
D7	5.6V	Zener			912747	Mullard BZY88 C5V6
D8	5.6V	Zener			912747	Mullard BZY88 C5V6
D9					914898	STC 1N4149
D10					914067	Mullard BZY88 C4V7

Cct. Ref.	Value	Description	Rat	Tal %	Racal Part Number	Manufacturer
		Diodes				
D11					914898	STC 1N4149
D12	12V	Zener			914310	Mullard BZY88 C12V
D13					914898	STC 1N4149
D14					914898	STC 1N4149
D15	5.6V	Zener			912747	Mullard 8ZY88 C5V6
D16					914898	STC 1N4149
D17					914898	STC 1N4149
D18					914898	STC 1N4149
D19					914898	STC 1N4149
D20					914898	STC 1N4149
D21	3.3V	Zener			912567	Mullard 8ZY88 C3V3
D22	3.3V	Zener			912567	Mullard BZY88 C3V3
D23					914898	STC 1N4149
D24					914898	STC 1N4149
D25	4.7V	Zener			914067	Mullard BZY88 C4V7
D26					914898	STC 1N4149
D27					914898	STC 1N4149
D28					914898	STC 1N4149
D29	4.7V	Zener			914067	Mullard BZY88 C4V7
D30	5.1V	Zener			912059	Mullard BZY88 C5V1
D31	4.7V	Zener			914067	Mullard 8ZY88 C4V7
D32	5.1V	Zener			912059	Mullard BZY88 C5V1
D33					916620	SGS 8AX54
D34					916620	SGS 8AX54
D35					914898	STC 1N4149
D36					914898	STC 1N4149
D37					914898	STC 1N4149
D38	5.1V	Zener			912059	Mullard 8ZY88 C5V1
D39					914898	STC 1N4149
D40					914898	STC 1N4149
D41					914898	STC 1N4149
D42	4.7V	Zener			914067	Mullard 8ZY88 C4V7
D43	4.7V	Zener			914067	Mullard 8ZY88 C4V7
D44	4.7V	Zener			914067	Mullard BZY88 C4V7
D45					914898	STC 1N4149

Cct. Ref.	Value	Description	Rat	Tal %	Racal Part Number	Manufacturer
		Diodes				
D46					914898	STC 1N4149
D47	8.2V	Zener			917622	Mullard BZY88 C8V2
D48					914898	STC 1N4149
D49					914898	STC 1N4149
D50	4.7V	Zener			914067	Mullard BZY88 C4V7
D51					914898	STC 1N4149
D52	4.7V	Zener			914067	Mullard BZY88 C4V7
		Integrated Circuits				
ML1		Operational Amplifier			923139	Fairchild μA748
ML2		Operational Amplifier			923139	Fairchild μA748
		Relays				
RLA					921450	Astralux GB831 C-4
RLB					921451	Astralux GB831 A-6

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		MIXER AND OUTPUT BOARD PM342 FIG.15				
		Resistors				
R1	56	Composition	1/3	10	919185	Dubilier BT103-6
R2	270	Composition	1/3	10	918077	Dubilier BT103-6
R3	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R4	1k	Composition	1/3	10	918075	Dubilier BT103-6
R5	18	Composition	1/3	10	919178	Dubilier BT103-6
R6	82	Composition	1/3	10	919817	Dubilier BT103-6
R7	27	Composition	1/3	10	918818	Dubilier BT103-6
R8	82	Composition	1/3	10	919817	Dubilier BT103-6
R9	100	Metal Oxide		2	913793	Electrosil TR5
R10	100	Metal Oxide		2	913793	Electrosil TR5
R11	390	Metal Oxide		2	909771	Electrosil TR5
R12	120	Composition	1/3	10	920850	Dubilier BT103-6
R13	47	Metal Oxide		2	918744	Electrosil TR5
R14	47	Metal Oxide		2	918744	Electrosil TR5
R15	470	Metal Oxide		2	918030	Electrosil TR5
R16	120	Composition	1/3	10	920850	Dubilier BT103-6
R17	56	Composition	1/3	10	919185	Dubilier BT103-6
R18	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R19	1k	Composition	1/3	10	918075	Dubilier BT103-6
R20	10	Composition	1/3	10	919173	Dubilier BT103-6
R21	82	Composition	1/3	10	919817	Dubilier BT103-6
R22	390	Metal Oxide		2	909771	Electrosil TR5
R23	120	Composition	1/3	10	920850	Dubilier BT103-6
R24	47	Metal Oxide		2	918744	Electrosil TR5
R25	47	Metal Oxide		2	911930	Electrosil TR4
R26	47	Metal Oxide		2	91B744	Electrosil TR5
R27	470	Metal Oxide		2	918030	Electrosil TR5
R28	120	Composition	1/3	10	920850	Dubilier BT103-6
R29	820	Composition	1/3	10	919112	Dubilier BT103-6
R30	470	Composition	1/3	10	919187	Dubilier BT103-6
R31	270	Metal Oxide		2	910391	Electrosil TR4
R32	270	Composition	1/3	10	918077	Dubilier BT103-6
R33	33	Composition	1/3	10	919176	Dubilier BT103-6
R34	2.7k	Composition	1/3	10	919170	Dubilier BT103-6
R35	560	Composition	1/3	10	919164	Dubilier BT103-6

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Resistors (Contd.)				
R36	56	Composition	1/3	10	919185	Dubilier BT103-6
R37	56	Composition	1/3	10	919185	Dubilier BT103-6
R38	82	Composition	1/3	10	919817	Dubilier BT103-6
R39	150	Composition	1/3	10	919189	Dubilier BT103-6
R40	2.7k	Composition	1/3	10	919170	Dubilier BT103-6
R41	560	Composition	1/3	10	919164	Dubilier BT103-6
R42	39	Composition	1/3	10	920052	Dubilier BT103-6
R43	150	Composition	1/3	10	919189	Dubilier BT103-6
R44	56	Composition	1/3	10	919185	Dubilier BT103-6
R45	100	Metal Oxide		2	913973	Electrosil TR5
R46	68	Composition	1/3	10	919186	Dubilier BT103-6
R47	100	Metal Oxide		2	913973	Electrosil TR5
R48	2.2k	Composition	1/3	10	919169	Dubilier BT103-6
R49	470	Composition	1/3	10	919187	Dubilier BT103-6
R50	270	Composition	1/3	10	918077	Dubilier BT103-6
R51	56	Composition	1/3	10	919185	Dubilier BT103-6
R52	18	Composition	1/3	10	919178	Dubilier BT103-6
R53	56	Composition	1/3	10	919185	Dubilier BT103-6
R54	270	Composition	1/3	10	918077	Dubilier BT103-6
R55	1.5k	Composition	1/3	10	919180	Dubilier BT103-6
R56	680	Composition	1/3	10	919191	Dubilier BT103-6
R57	56	Composition	1/3	10	919185	Dubilier BT103-6
R58	82	Metal Oxide		2	909550	Electrosil TR5
R59	1k	Composition	1/3	10	918075	Dubilier BT103-6
R60	470	Composition	1/3	10	919187	Dubilier BT103-6
R61	56	Composition	1/3	10	919185	Dubilier BT103-6
R62	68	Metal Oxide		2	918047	Electrosil TR5
R63	82k	Composition	1/3	10	920065	Dubilier BT103-6
R64	50k	Linear			921376	Daystrom 56700HS
R65	47	Metal Oxide		2	911930	Electrosil TR4
R66	330	Metal Oxide		2	915690	Electrosil TR4
R67	1k	Composition	1/3	10	918075	Dubilier BT103-6
R68	270	Composition	1/3	10	918077	Dubilier BT103-6
R69	27	Composition	1/3	10	918818	Dubilier BT103-6
R70	50	Linear			921481	Daystrom 56700HS

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Resistors (Contd.)				
R71	680	Metal Oxide	1/3	10	919321	Electrosil TR5
R72	1k	Metal Oxide	1/3	10	907731	Electrosil TR5
R73	1k	Campasition	1/3	10	918075	Dubilier BT103-6
R74	4.7k	Compasition	1/3	10	919165	Dubilier BT103-6
R75	1k	Compasition	1/3	10	918075	Dubilier BT103-6
		Capocitors				
C1	0.1	Polycorbonate	100V	+80-20	914173	STC PMC 2R/0.1/M100
C2	.01	Ceromic	250V	+80-20	921460	Erie 801/K2600
C3	.01	Ceramic	250V	+80-20	921460	Erie 801/K2600
C4	.01	Ceromic	250V	+80-20	921460	Erie 801/K2600
C5	0.1	Palycorbonate	100V	20	914173	STC PMC 2R/0.1/M100
C6	15p	Polystyrene	125V	$2\frac{1}{2}$	921459	Salford PF
C7	12p	Palystyrene	125V	$2\frac{1}{2}$	921461	Solford PF
C8	15p	Polystyrene	125V	$2\frac{1}{2}$	921459	Salford PF
C9	0.1	Polycorbonate	100V	20	914173	STC PMC 2R/0.1/M100
C10	3.3p	Ceramic	500V	$\pm\frac{1}{2}$p	917744	Erie 831 P100
C11	47p	Polystyrene	125V	$2\frac{1}{2}$	908318	Salford PF
C12	18p	Polystyrene	125V	$2\frac{1}{2}$	921463	Salford PF
C13	15p	Polystyrene	125V	$2\frac{1}{2}$	921459	Salford PF
C14	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C15	3.3p	Ceramic	500V	$\pm\frac{1}{2}$p	917744	Erie 831 P100
C16	39p	Polystyrene	125V	$2\frac{1}{2}$	921464	Salford PF
C17	0.1	Palycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C18	3.3p	Ceramic	500V	$\pm\frac{1}{2}$p	917744	Erie 831 P100
C19	5.6p	Ceramic	500V	$\pm\frac{1}{2}$	902008	Erie 831 P100
C20	.01	Ceramic	250V	+80-20	921460	Erie 801/K2600
C21	3.3p	Ceramic	500V	$\pm\frac{1}{2}$p	917744	Erie 831 P100
C22	47p	Polystyrene	125V	$2\frac{1}{2}$	908318	Salford PF
C23	18p	Polystyrene	125V	$2\frac{1}{2}$	921463	Solford PF
C24	15p	Polystyrene	125V	$2\frac{1}{2}$	921459	Salford PF
C25	.01	Ceromic	250V	+80-20	921460	Erie 801/K2600
C26	.01	Ceromic	250V	+80-20	921460	Erie 801/K2600
C27	3.3p	Ceromic	500V	$\pm\frac{1}{2}$p	917744	Erie 831 P100
C28	15p	Polystyrene	125V	$2\frac{1}{2}$	921459	Salford PF
C29	15p	Polystyrene	125V	$2\frac{1}{2}$	921459	Salford PF
C30	12p	Polystyrene	125V	$2\frac{1}{2}$	921461	Salford PF

Cct. Ref.	Value	Description	Rat	Tal %	Racal Part Number	Manufacturer
		Copacitors (Contd.)				
C31	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C32	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C33	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C34	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C35	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C36	.01	Ceramic	250	+80-20	921460	Erie 801/K2600
C37	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C38	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C39	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C40	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C41	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C42	0.1	Polycarbonote	100V	20	914173	STC PMC 2R/0.1/M100
C43	0.1	Polycarbonote	100V	20	914173	STC PMC 2R/0.1/M100
C44	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C45	4.7	Electrolytic	35	20	914026	Kemet K4R7E35
C46	0.1	Polycorbonate	100V	20	914173	STC PMC 2R/0.1/M100
C47	0.1	Polycorbonote	100V	20	914173	STC PMC 2R/0.1/M100
C48	13.3p	Polystyrene	30V	2½	921466	Suflex HS
C49		Not Used				
C50	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C51	15p	Polystyrene	125V	2½	921459	Solford PF
C52		Not Used				
C53	160p	Polystyrene	30V	2½	922255	Suflex HS
C54	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C55	106p	Polystyrene	30V	2½	921465	Suflex HS
C56	106p	Polystyrene	30V	2½	921465	Suflex HS
C57	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C58	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C59	148p	Polystyrene	30V	2½	921468	Suflex HS
C60		Not Used				
C61		Not Used				
C62	124p	Polystyrene	30V	2½	921469	Suflex HS
C63	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100
C64		Not Used				
C65	0.1	Polycarbonate	100V	20	914173	STC PMC 2R/0.1/M100

Cct. Ref.	Value	Description	Rat	Tal %	Racal Part Number	Manufacturer
		Capacitors (Contd.)				
C66	63p	Polystyrene	30V	2½	921470	Suflex HS
C67		Not Used				
C68	100p	Polystyrene	30V	2½	913230	Suflex HS
C69	.033	Transcap	8V	+50-20	911883	Erie Transcap 831/T
C70	150p	Ceramic	500V	10	917742	Erie 831 H3300
C71	150p	Ceramic	500V	10	917742	Erie 831 H3300
C72	0.1	Polycarbonate	100V	20	914173	STC PMC2R/0.1/M100
C73	0.1	Polycarbonate	100V	20	914173	STC PMC2R/0.1/M100
C74	4.7	Electrolytic	35V	20	914026	Kemet K4R7E35
C75	4.7	Electrolytic	35V	20	914026	Kemet K4R7E35
C76	4.7	Electrolytic	35V	20	914026	Kemet K4R7E35
		Inductors				
L1	68				915851	Painton Type C20M
L2					CT603471	Racal
L3					CT603472	Racal
L4					CT603471	Racal
L5	68				915851	Painton Type C20M
L6					CT603472	Racal
L7					CT603471	Racal
L8					CT603473	Racal
L9					CT603475	Racal
L10					CT603474	Racal
L11					CT603476	Racal
		Transformers				
T1					CT603466	Racal
T2					CT603466	Racal
T3					CT603467	Racal
T4					CT603467	Racal
T5					CT603468	Racal
T6					CT603469	Racal
T7					CT603470	Racal
T8					CT603466	Racal
T9					CT603470	Racal
T10					CT603466	Racal

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Transformers (Contd.)				
T11					CT603470	Racal
T12					CT603470	Racal
T13					CT603470	Racal
		Transistors				
TR1		Silicon n-p-n			917219	Mullard 2N3866
TR2		Silican n-p-n			917219	Mullard 2N3866
TR3		Silicon n-p-n			917219	Mullard 2N3866
TR4		Silicon n-p-n			917219	Mullard 2N3866
TR5		Silicon n-p-n			917219	Mullard 2N3866
TR6		Silicon n-p-n			917219	Mullard 2N3866
TR7		Silicon n-p-n			916627	Mullard 8FX89
TR8		Silicon n-p-n			916632	Mullard 8SX61
TR9		Silicon n-p-n			916632	Mullard 8SX61
TR10		Silicon n-p-n			916632	Mullard BSX61
TR11		Silicon n-p-n			916632	Mullard 8SX61
TR12		Silicon n-p-n			916632	Mullard 8SX61
TR13		Silicon n-p-n			916632	Mullard 8SX61
TR14		Silicon n-p-n			916627	Mullard 8FX89
TR15		Silicon n-p-n			916632	Mullard 8SX61
TR16		Silicon p-n-p			915267	Mullard BFX29
TR17		Silicon n-p-n			906842	Mullard 2N2369
		Diodes				
D1-D4		Matched Quad			916623	H.P.5082-2805
D5-D8		Matched Quad			916623	H.P.5082-2805
D9					900069	Mullard OA 47
D10					900069	Mullard OA 47
		Ferrite Beads				
FB1					900461	Mullard FX 1115
FB2					900461	Mullard FX 1115
FB3					900461	Mullard FX 1115
FB4					900461	Mullard FX 1115
FB5					900461	Mullard FX 1115

Cct. Ref.	Value	Description	Rat	Tal %	Racal Part Number	Manufacturer
		Ferrite Beads (Contd.)				
FB6					900461	Mullard FX 1115
FB7					900461	Mullard FX 1115
FB8					900461	Mullard FX 1115
FB9					900461	Mullard FX 1115
FB10					900461	Mullard FX 1115
FB11					90748B	Mullard FX 1242
FB12					900461	Mullard FX 1115
FB13					900461	Mullard FX 1115
FB14					9074BB	Mullard FX 1242
FB15					900461	Mullard FX 1115
FB16					900461	Mullard FX 1115
FB17					907488	Mullard FX 1242
FB18					900461	Mullard FX 1115
FB19					900461	Mullard FX 1115
FB20					907488	Mullard FX 1242
FB21					900461	Mullard FX 1115
FB22					900461	Mullard FX 1115
FB23		Not Used				
FB24					900461	Mullard FX 1115
FB25					900461	Mullard FX 1115
FB26					900461	Mullard FX 1115
FB27					900461	Mullard FX 1115
FB28					907488	Mullard FX 1242
		Filter				
F1		Crystal Filter 34.5MHz			BD44454	Racal

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		POWER SUPPLY BOARD PM343 FIG.21				
		Resistors				
R1	1	Wirewound	6		914884	Welwyn W22
R2	1	Wirewound	6		914884	Welwyn W22
R3	1	Wirewound	6		914884	Welwyn W22
R4	1	Wirewound	6		914884	Welwyn W22
R5	1.8k	Composition	1/3	10	919177	Dubilier BT103-6
R6	6.8k	Composition	1/3	10	919192	Dubilier BT103-6
R7	2.2k	Composition	1/3	10	919169	Dubilier BT103-6
R8	1.2k	Composition	1/3	10	919172	Dubilier BT103-6
R9	500	Linear			921476	Doystrom 56700HS
R10	3.3k	Composition	1/3	10	919168	Dubilier BT103-6
R11	8.2k	Composition	1/3	10	919182	Dubilier 8T103-6
R12	10k	Linear			921477	Doystrom 56700HS
R13	10k	Composition	1/3	10	918073	Dubilier BT103-6
R14	12k	Composition	1/3	10	919190	Dubilier BT103-6
R15	3.3k	Composition	1/3	10	919168	Dubilier 8T103-6
R16	1k	Composition	1/3	10	918075	Dubilier BT103-6
R17	1.8k	Composition	1/3	10	919177	Dubilier BT103-6
R18	6.8k	Composition	1/3	10	919192	Dubilier BT103-6
R19	3.9k	Composition	1/3	10	919166	Dubilier BT103-6
R20	1.8k	Composition	1/3	10	919177	Dubilier BT103-6
R21	6.8k	Composition	1/3	10	919192	Dubilier BT103-6
R22	5k	Linear			921328	Daystrom 56700HS
R23	1k	Linear			921476	Daystrom 56700HS
R24	1k	Composition	1/3	10	918075	Dubilier BT103-6
R25	1k	Composition	1/3	10	918075	Dubilier BT103-6
R26	1k	Composition	1/3	10	918075	Dubilier BT103-6
R27	22k	Composition	1/3	10	918074	Dubilier BT103-6
R28	2.2k	Composition	1/3	10	919169	Dubilier BT103-6
R29	1k	Composition	1/3	10	918075	Dubilier BT103-6
		Capacitors				
C1	4.7	Electrolytic	35	20	914026	Kemet K4R7E35
C2	4.7	Electrolytic	35	20	914026	Kemet K4R7E35
C3	4.7	Electrolytic	35	20	914026	Kemet K4R7E35
C4	4.7	Electrolytic	35	20	914026	Kemet K4R7E35
C5	0.1	Polycarbonate	100V	20	914173	STC PMC2R/0.1/M100

Cct. Ref.	Value	Description	Rat	Tal %	Racal Part Number	Manufacturer
		Capacitors (Contd.)				
C6	0.1	Polycarbonate	100V	20	914173	STC PMC2R/0.1/M1
C7	0.1	Polycarbonate	100V	20	914173	STC PMC2R/0.1/M1
C8	0.1	Polycarbonate	100V	20	914173	STC PMC2R/0.1/M1
C9	1500	Electralytic	6.3		921457	Mullard 10813152
C10	4.7	Electralytic			914026	Kemet K4R7E35
C11	4.7	Electrolytic			914026	Kemet K4R7E35
C12	4.7	Electralytic			914026	Kemet K4R7E35
		Transistors				
TR1		Silicon n-p-n			908753	Mullard 8FY51
TR2		Silicon n-p-n			908753	Mullard 8FY51
TR3		Silicon n-p-n			908753	Mullard 8FY51
		Rectifiers				
D1		Rectifier Bridge			918158	International Rectifiers 10DB05A
		Integrated Circuits				
ML1		Voltage Regulator			916155	Fairchild μA723C
ML2		Voltage Regulator			916155	Fairchild μA723C
ML3		Voltage Regulator			916155	Fairchild μA723C
ML4		Voltage Regulator			916155	Fairchild μA723C

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		34MHz GENERATOR PM344 FIG.3				
		Resistors				
R1	330	Composition	1/3	10	919179	Dubilier BT103-6
R2	56	Composition	1/3	10	919185	Dubilier BT103-6
R3	1k	Composition	1/3	10	918075	Dubilier BT103-6
R4	3.3k	Composition	1/3	10	919168	Dubilier BT103-6
R5	1.8k	Composition	1/3	10	919177	Dubilier BT103-6
R6	220	Composition	1/3	10	919174	Dubilier BT103-6
R7	820	Composition	1/3	10	919112	Dubilier BT103-6
R8	1k	Composition	1/3	10	918075	Dubilier BT103-6
R9	100	Composition	1/3	10	918076	Dubilier BT103-6
R10	1k	Composition	1/3	10	918075	Dubilier BT103-6
R11		Not Used				
R12	10	Composition	1/3	10	919173	Dubilier BT103-6
R13	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R14	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R15	1k	Composition	1/3	10	918075	Dubilier BT103-6
R16	47	Composition	1/3	10	919622	Dubilier BT103-6
R17	100	Composition	1/3	10	918076	Dubilier BT103-6
R18	10	Composition	1/3	10	919173	Dubilier BT103-6
R19	220	Composition	1/3	10	919174	Dubilier BT103-6
R20	100	Composition	1/3	10	918076	Dubilier BT103-6
R21	680	Composition	1/3	10	919191	Dubilier BT103-6
R22	680	Composition	1/3	10	919191	Dubilier BT103-6
R23	47	Composition	1/3	10	919622	Dubilier BT103-6
R24	3.3k	Composition	1/3	10	919168	Dubilier BT103-6
R25	10k	Composition	1/3	10	918073	Dubilier BT103-6
R26	680	Composition	1/3	10	919191	Dubilier BT103-6
R27	680	Composition	1/3	10	919191	Dubilier BT103-6
R28	6.8k	Composition	1/3	10	919192	Dubilier BT103-6
R29	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R30	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R31	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R32	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R33	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R34	4.7k	Composition	1/3	10	919165	Dubilier BT103-6

Cct. Ref.	Value	Description	Rat	Tal %	Racal Part Number	Manufacturer
		Capacitors				
C1	330p	Palystyrene	30V	2	921073	Suflex EP9
C2	0.1	Palycarbonate	100V	20	914173	STC PMC2R/0.1/M100
C3	56p	Polystyrene	30V	2	921024	Suflex EP9
C4	0.033	Ceramic	18V	+50-25	911883	Erie 831/T/18V
C5	100p	Palystyrene	30V	2	921026	Suflex EP9
C6	0.01	Ceramic	25V	+50-25	911845	Erie 831/T/25V
C7	0.1	Palycarbonate	100V	20	914173	STC PMC2R/0.1/M100
C8	1000p	Ceramic	500	20	915243	Erie 831 K2600
C9	0.1	Polycarbonate	100V	20	914173	STC PMC2R/0.1/M100
C10	1000p	Ceramic	500V	20	915243	Erie 831 K2600
C11	0.1	Polycarbonate	100V	20	914173	STC PMC2R/0.1/M100
C12	33p	Polystyrene	30V	2	921226	Suflex EP9
C13	68p	Palystyrene	30V	2	921271	Erie 831 K2600
C14	1000p	Ceramic	500V	20	915243	Erie 831 K2600
C15	33p	Palystyrene	30V	2	921226	Suflex EP9
C16	1000p	Ceramic	500V	20	915243	Erie 831 K2600
C17	1000p	Ceramic	500V	20	915243	Erie 831 K2600
C18	1000p	Ceramic	500V	20	915243	Erie 831 K2600
C19	100p	Polystyrene	30V	2	921026	Suflex EP9
C20	0.1µ	Polycarbonate	100V	20	914173	STC PMC2R/0.1/M100
C21	0.01µ	Polycarbonate	100V	20	914171	STC PMC2R/0.1/M100
C22	22µ	Electrolytic		10	920263	Union Carbide K22E16KS
C23	1000p	Polystyrene	30V	2	921260	Suflex EP9
C24	0.1	Polycarbonate		2	914173	STC PMC2R/0.1/M100
		Inductors				
L1					CT603477	Racal
L2	4.7µ				919404	Painton 58/10/0051/10
L3		Not Used				
L4	1µ				915852	Painton 58/10/0047/10
L5	1µ				915852	Painton 58/10/0047/10

Cct. Ref.	Value	Description	Rat	Tal %	Racal Part Number	Manufacturer
		Transistors				
TR1		Silicon n-p-n			908753	Mullard BFY 51
TR2		Silicon n-p-n			916627	Mullard BFX 89
TR3		Silicon n-p-n			906842	Mullard 2N2369
TR4		Silican n-p-n			916627	Mullard BFX 89
TR5		Silicon n-p-n			906842	Mullard 2N2369
TR6		Silicon n-p-n			906842	Mullard 2N2369
TR7		Silicon p-n-p			915231	SGS BFX 48
TR8		Silicon n-p-n			906842	Mullard 2N2369
TR9		Silicon n-p-n			906842	Mullard 2N2369
TR10		Silican n-p-n			906842	Mullard 2N2369
TR11		Silicon n-p-n			906842	Mullard 2N2369
		Diodes				
D1	5.6V	Zener			912747	Mullard BZY88C5V6
D2					917731	Motorala MV1634
D3					914898	STC 1N4149
		Integrated Circuits				
ML1		Quad 2 input Nand gate			921221	Texas SN74H00J
ML2		Decade Divider			917494	ITT MIC 7490J
ML3		Dual J-K Flip Flop			924006	Transitron SN74H103J
ML4		Quad 2 input Nand gate			918366	ITT MIC 7400J
ML5		Decade Divider			920333	Signetics N8290A
ML6		Quod 2 input Nand gate			921221	Texas SN74H00J
ML7		Dual D Flip Flop			917509	ITT MIC 7474J
ML8		Quad 2 input Nand gate			918366	ITT MIC 7400J
ML9		Quad 2 input Nor gate			919502	ITT MIC 7402J
ML10		Quod 2 input Nor gate			919502	ITT MIC 7402J

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		CONTROL BOARD PM345 FIG. 19				
		Resistors				
R1	1k	Composition	1/3	10	918075	Dubilier BT103-6
R2	2.2k	Composition	1/3	10	919169	Dubilier BT103-6
R3	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R4	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R5	820	Composition	1/3	10	919112	Dubilier BT103-6
R6	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R7	330	Composition	1/3	10	919179	Dubilier BT103-6
R8	470	Composition	1/3	10	9191B7	Dubilier BT103-6
R9	1k	Composition	1/3	10	91B075	Dubilier BT103-6
R10	39k	Composition	1/3	10	919623	Dubilier BT103-6
R11	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R12	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R13	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R14	330	Composition	1/3	10	919179	Dubilier BT103-6
R15	330	Composition	1/3	10	919179	Dubilier BT103-6
R16	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R17	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R18	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R19	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R20	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R21	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R22	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R23	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R24	1k	Composition	1/3	10	91B075	Dubilier BT103-6
R25	330	Composition	1/3	10	919179	Dubilier BT103-6
R26	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R27	1k	Composition	1/3	10	91B075	Dubilier BT103-6
R28	470	Composition	1/3	10	9191B7	Dubilier BT103-6
R29	470	Composition	1/3	10	9191B7	Dubilier BT103-6
R30	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R31	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R32	1k	Composition	1/3	10	91B075	Dubilier BT103-6
R33	820	Composition	1/3	10	919112	Dubilier BT103-6
R34	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R35	330	Composition	1/3	10	919	Dubilier BT103-6

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Resistors (Contd.)				
R36	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R37	1k	Composition	1/3	10	918075	Dubilier BT103-6
R38	1.5k	Compasition	1/3	10	919180	Dubilier BT103-6
R39	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R40	56	Compasition	1/3	10	9191B5	Dubilier BT103-6
R41	3.3k	Composition	1/3	10	919168	Dubilier BT103-6
R42	1.8k	Composition	1/3	10	919177	Dubilier BT103-6
R43	1k	Composition	1/3	10	918075	Dubilier BT103-6
R44	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R45	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R46	1k	Composition	1/3	10	91B075	Dubilier BT103-6
R47	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R48	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R49	1k	Composition	1/3	10	918075	Dubilier BT103-6
		Capacitors				
C1	0.1	Polycarbonate	100V	20	914173	STC PMC2R/0.1/M100
C2	0.1	Polycarbonate	100V	20	914173	STC PMC2R/0.1/M100
C3	0.1	Polycarbonate	100V	20	914173	STC PMC2R/0.1/M100
C4	47	Electrolytic	6.3	20	915100	Kemet K47 E6
C5	47	Electrolytic	6.3	20	915100	Kemet K47 E6
C6	0.1	Polycarbonate	100V	20	914173	STC PMC2R/0.1/M100
C7	0.1	Polycarbonate	100V	20	914173	STC PMC2R/0.1/M100
C8	0.1	Polycarbonate	100V	20	914173	STC PMC2R/0.1/M100
C9	0.1	Polycarbonate	100V	20	914173	STC PMC2R/0.1/M100
C10	0.1	Polycarbonate	100V	20	914173	STC PMC2R/0.1/M100
C11	0.1	Polycarbonate	100V	20	914173	STC PMC2R/0.1/M100
C12	0.1	Polycarbanate	100V	20	914173	STC PMC2R/0.1/M100
		Transistors				
TR1		Silicon n-p-n			906B42	Mullard 2N2369
TR2		Silicon n-p-n			906B42	Mullard 2N2369
TR3		Silicon n-p-n			906B42	Mullard 2N2369
TR4		Silicon n-p-n			911929	Mullard BC107
TR5		Silicon p-n-p			915231	Mullard BFX48

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Transistors (Contd.)				
TR6		Silicon n-p-n			911929	Mullard BC107
TR7		Silicon p-n-p			915231	Mullard BFX 48
TR8		Silicon n-p-n			906842	Mullard 2N2369
TR9		Silicon n-p-n			911929	Mullard BC107
TR10		Silicon n-p-n			906842	Mullard 2N2369
TR11		Silicon p-n-p			915231	Mullard BFX 48
TR12		Silicon n-p-n			906842	Mullard 2N2369
TR13		Silicon n-p-n			906842	Mullard 2N2369
TR14		Silicon n-p-n			906842	Mullard 2N2369
TR15		Silicon p-n-p			915231	Mullard BFX 48
TR16		Silicon n-p-n			906842	Mullard 2N2369
TR17		Silicon n-p-n			906842	Mullard 2N2369
TR18		Silicon n-p-n			906842	Mullard 2N2369
TR19		Silicon n-p-n			906842	Mullard 2N2369
		Diodes				
D1					914898	Mullard 1N4149
D2	6.2V	Zener			911682	Mullard BZY886V2
D3					914898	Mullard 1N4149
D4					914898	Mullard 1N4149
D5					914898	Mullard 1N4149
D6					914898	Mullard 1N4149
D7					914898	Mullard 1N4149
D8	6.2V	Zener			911682	Mullard BZY886V2
D9					914898	Mullard 1N4149
D10		Not Used				
D11					914898	Mullard 1N4149
D12		Not Used				
D13	8.2V	Zener			917622	Mullard BZY888V2
D14					914898	Mullard 1N4149
D15					914898	Mullard 1N4149
D16					914898	Mullard 1N4149
D17					914898	Mullard 1N4149
D18	4.7V	Zener			914067	Mullard BZY884V7
D19					914898	Mullard 1N4149
D20					914898	Mullard 1N4149

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Integrated Circuits				
ML1		Dual 3 input Nand gate			919493	ITT MIC 7420J
ML2		Quad 2 input Nand gate			918366	ITT MIC 7400J
ML3		Quad 2 input Nand gate			918366	ITT MIC 7400J
ML4		Manostable			921258	ITT MIC 74121J

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		NOISE IMMUNITY BOARD PM346 FIG. 17				
		Resistors				
R1	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R2	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R3	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R4	4.7k	Composition	1/3	10	919165	Dubilier BT103-5
R5	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R6	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R7	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R8	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R9	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R10	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R11	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R12	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R13	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R14	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R15	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R16	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R17	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R18	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R19	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R20	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R21	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R22	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R23	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R24	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R25	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R26	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R27	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R28	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R29	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R30	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R31	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R32	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R33	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R34	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R35	4.7k	Composition	1/3	10	919165	Dubilier BT103-6

Cct. Ref.	Volue	Description	Rat	Tol %	Racal Part Number	Manufocturer
		Resistors (Contd.)				
R36	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R37	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R38	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R39	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R40	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R41	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R42	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R43	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R44	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R45	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R46	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R47	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R48	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
		Transistors				
TR1		Silicon n-p-n			906842	ITT 2N2369
TR2		Silicon n-p-n			906842	ITT 2N2369
TR3		Silicon n-p-n			906842	ITT 2N2369
TR4		Silicon n-p-n			906842	ITT 2N2369
TR5		Silicon n-p-n			906842	ITT 2N2369
TR6		Silicon n-p-n			906842	ITT 2N2369
TR7		Silicon n-p-n			906842	ITT 2N2369
TR8		Silicon n-p-n			906842	ITT 2N2369
TR9		Silicon n-p-n			906842	ITT 2N2369
TR10		Silicon n-p-n			906842	ITT 2N2369
TR11		Silicon n-p-n			906842	ITT 2N2369
TR12		Silicon n-p-n			906842	ITT 2N2369
TR13		Silicon n-p-n			906842	ITT 2N2369
TR14		Silicon n-p-n			906842	ITT 2N2369
TR15		Silicon n-p-n			906842	ITT 2N2369
TR16		Silicon n-p-n			906842	ITT 2N2369
TR17		Silicon n-p-n			906842	ITT 2N2369
TR18		Silicon n-p-n			906842	ITT 2N2369
TR19		Silicon n-p-n			906842	ITT 2N2369
TR20		Silicon n-p-n			906842	ITT 2N2369

Cct. Ref.	Volue	Description	Rat	Tol %	Racol Part Number	Manufacturer
		Transistors (Contd.)				
TR21		Silicon n-p-n			906842	ITT 2N2369
TR22		Silicon n-p-n			906842	ITT 2N2369
TR23		Silicon n-p-n			906842	ITT 2N2369
TR24		Silicon n-p-n			906842	ITT 2N2369
		Diodes				
D1					914898	ITT 1N4149
D2					914898	ITT 1N4149
D3					914898	ITT 1N4149
D4					914898	ITT 1N4149
D5					914898	ITT 1N4149
D6					914898	ITT 1N4149
D7					914898	ITT 1N4149
D8					914898	ITT 1N4149
D9					914898	ITT 1N4149
D10					914898	ITT 1N4149
D11					914898	ITT 1N4149
D12					914898	ITT 1N4149
D13					914898	ITT 1N4149
D14					914898	ITT 1N4149
D15					914898	ITT 1N4149
D16					914898	ITT 1N4149
D17					914898	ITT 1N4149
D18					914898	ITT 1N4149
D19					914898	ITT 1N4149
D20					914898	ITT 1N4149
D21					914898	ITT 1N4149
D22					914898	ITT 1N4149
D23					914898	ITT 1N4149
D24					914898	ITT 1N4149

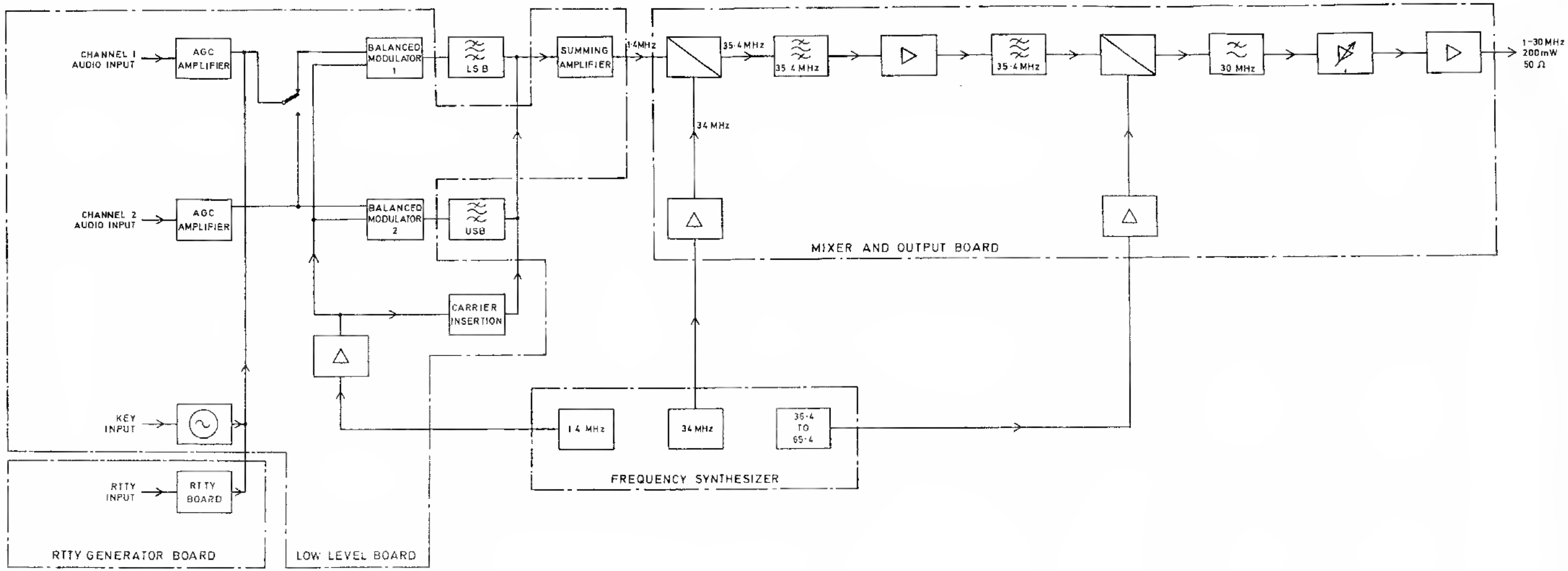
Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		FREQUENCY SYNTHESIZER PM349 FIG. 5				
		Resistors				
R1	330	Composition	1/3	10	919179	Dubilier BT103-6
R2	3.3k	Composition	1/3	10	91916B	Dubilier BT103-6
R3	150	Wirewound	$2\frac{1}{2}$		913600	Welwyn W21
R4	220	Composition	1/3	10	919174	Dubilier BT103-6
R5	220	Composition	1/3	10	919174	Dubilier BT103-6
R6	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R7	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R8	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R9	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R10	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R11	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R12	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R13	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R14	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R15	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R16	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R17	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R18	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R19	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R20	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R21	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R22	1k	Composition	1/3	10	91B075	Dubilier BT103-6
R23	1k	Composition	1/3	10	91B075	Dubilier BT103-6
R24	2.2k	Composition	1/3	10	919169	Dubilier BT103-6
R25	1k	Composition	1/3	10	91B075	Dubilier BT103-6
R26	33	Composition	1/3	10	919176	Dubilier BT103-6
R27	2.2k	Composition	1/3	10	919169	Dubilier BT103-6
R28	1k	Composition	1/3	10	91B075	Dubilier BT103-6
R29	470	Composition	1/3	10	9191B7	Dubilier BT103-6
R30	15k	Composition	1/3	10	91B07B	Dubilier BT103-6
R31	4.7k	Composition	1/3	10	919165	Dubilier BT103-6
R32	1k	Composition	1/3	10	91B075	Dubilier BT103-6
R33	470	Composition	1/3	10	919187	Dubilier BT103-6
R34	680	Composition	1/3	10	919191	Dubilier BT103-6
R35	330	Composition	1/3	10	919179	Dubilier BT103-6

Cct. Ref.	Value	Description	Rat	Tal %	Racal Part Number	Manufacturer
		Resistors (Contd.)				
R36	680	Composition	1/3	10	919191	Dubilier 8T103-6
R37	680	Composition	1/3	10	919191	Dubilier 8T103-6
R38	330	Composition	1/3	10	919179	Dubilier 8T103-6
R39	270	Composition	1/3	10	918077	Dubilier 8T103-6
R40	270	Composition	1/3	10	918077	Dubilier 8T103-6
R41	33k	Composition	1/3	10	919340	Dubilier 8T103-6
R42	33k	Composition	1/3	10	919340	Dubilier 8T103-6
R43	2.7k	Composition	1/3	10	919170	Dubilier 8T103-6
R44	100k	Composition	1/3	10	919163	Dubilier 8T103-6
R45	10k	Composition	1/3	10	918073	Dubilier 8T103-6
		Capacitors				
C1	220p	Ceramic	500V	10	914916	Erie 831/N4200
C2	100p	Ceramic	500V	10	917417	Erie 831/N3300
C3	33	Electralytic	10V	20	901100	Kemet K33 JIOS
C4	1000p	Polystyrene	30V	2	921260	Suflex EP9
C5	1000p	Palystyrene	30V	2	921260	Suflex EP9
C6	.01	Ceramic	25V	+50-25	911845	Erie 831/T/25V
C7	.01	Ceramic	25V	+50-25	911845	Erie 831/T/25V
C8	.01	Ceramic	25V	+50-25	911845	Erie 831/T/25V
C9	.01	Ceramic	25V	+50-25	911845	Erie 831/T/25V
C10	.01	Ceramic	25V	+50-25	911845	Erie 831/T/25V
C11	.01	Ceramic	25V	+50-25	911845	Erie 831/T/25V
C12	.01	Ceramic	25V	+50-25	911845	Erie 831/T/25V
C13	.01	Ceramic	25V	+50-25	911845	Erie 831/T/25V
C14	.01	Ceramic	25V	+50-25	911845	Erie 831/T/25V
C15	.01	Ceramic	25V	+50-25	911845	Erie 831/T/25V
C16	.01	Ceramic	25V	+50-25	911845	Erie 831/T/25V
C17	.01	Ceramic	25V	+50-25	911845	Erie 831/T/25V
C18	.01	Ceramic	25V	+50-25	911845	Erie 831/T/25V
C19	.01	Ceramic	25V	+50-25	911845	Erie 831/T/25V
C20	.01	Ceramic	25V	+50-25	911845	Erie 831/T/25V
C21	.01	Ceramic	25V	+50-25	911845	Erie 831/T/25V
C22	.01	Ceramic	25V	+50-25	911845	Erie 831/T/25V
C23	68p	Palystyrene	30V	2	921271	Suflex EP9
C24	100p	Palystyrene	30V	2	921026	Suflex EP9
C25	470p	Ceramic	500	10	917453	Erie 831/K170051

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Capacitors (Contd.)				
C26	100p	Polystyrene	30	2	921026	Suflex EP9
C27	0.1	Polycarbonate	100	20	914173	ITT PMC 2R.1M100
C28	1000p	Polystyrene	30	2	921260	Suflex EP9
C29	.01	Ceramic	25	+50-25	911845	Erie 831/T/25V
C30	.01	Ceramic	25	+50-25	911845	Erie 831/T/25V
C31	.01	Ceramic	25	+50-25	911845	Erie 831/T/25V
C32	0.1	Polycarbonate	100	20	914173	ITT PMC 2R.1M100
C33	0.1	Polycarbonate	100	20	914173	ITT PMC 2R.1M100
C34	33	Electrolytic	10	20	901100	Kemet K33 JIOS
C35	.1	Polycarbonate	100	20	914173	ITT PMC 2R.1M100
C36	.1	Polycarbanate	100	20	914173	ITT PMC 2R.1M100
C37	.1	Polycarbonate	100	20	914173	ITT PMC 2R.1M100
C38	.1	Polycarbonate	100	20	914173	ITT PMC 2R.1M100
C39	.22	Polyester	250	20	923713	ITT PMT 2R.22M250
C40	.1	Palycarbonate	100	20	914173	ITT PMC 2R.1M100
C41	4.7	Fixed	63	20	922235	Wima MKB 363V
C42	6.8	Electrolytic	35	20	910129	Kemet K6R8J35S
C43	.01	Ceramic	25	+50-25	911845	Erie 831/T/25V
C44	.01	Ceromic	25	+50-25	911845	Erie 831/T/25V
		Inductors				
L1	15μ	Voriable			915850	Delevan 1537-40
L2					CT76499	Racal
L3	33μ				919465	Delevan 1537-52
L4	1000μ				919033	Delevan 2500-28
L5	1μ				915849	Delevan 1537-12
L6	47μ				919466	Delevan 1537-60
L7	47μ				919466	Delevan 1537-60
		Transformers				
T1					CT76492	Racal
T2					CT76337	Racal

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Transistors				
TR1		Silican n-p-n			908753	Mullard BFY51
TR2		Silicon n-p-n			906842	Mullard 2N2369
TR3		Silicon n-p-n			914900	Mullard BC109
TR4		Silican n-p-n			914900	Mullard BC109
TR5		Silicon n-p-n			906842	Mullard 2N2369
TR6		Silican n-p-n			915231	Fairchild BFX48
TR7		Silican n-p-n			906842	Mullard 2N2369
TR8		F.E.T.			916946	Mullard BFW10
TR9		F.E.T.			916946	Mullard BFW10
TR10		Silicon n-p-n			914900	Mullard BC109
TR11		Silicon n-p-n			920331	Mullard 2N4338
		Diodes				
D1					920267	Mullard ZC714
D2	5.6V	Zener			912747	Mullard BZY88C5V6
		Integrated Circuits				
ML1		Triple 3 Input Nand gate			921220	ITT 74H10J
ML2		Presettable Decade			920330	Signetics N8290A
ML3		Decade Counter			917494	Tronsitron 7490J
ML4		Decade Counter			917494	Transitron 7490J
ML5		Presettable Decade Counter			920330	Signetics N8290A
ML6		Dual 4 Input And Gate			921266	Texas 74H21J
ML7		Decade Counter			917494	Transitron 7490J
ML8		Presettable Decade Counter			920330	Signetics N8290A
ML9		Dual J-K Flip Flop			921551	Texas 74H108J
ML10		Dual D Flip-Flop			917509	ITT 7474J
ML11		Presettable Decade Counter			920330	Signetics N8290A
ML12		Dual D Flip-Flop			917509	ITT 7474J
ML13		Presettable Decade Counter			920330	Signetics N8290A
ML14		Triple 3 Input Nand Gate			918361	ITT 7410J
ML15		Dual In-line			919493	ITT 7420J
ML16		Presettable Decade Counter			920330	Signetics N8290A
ML17		Triple 3 Input Nand Gate			918361	ITT 7410J

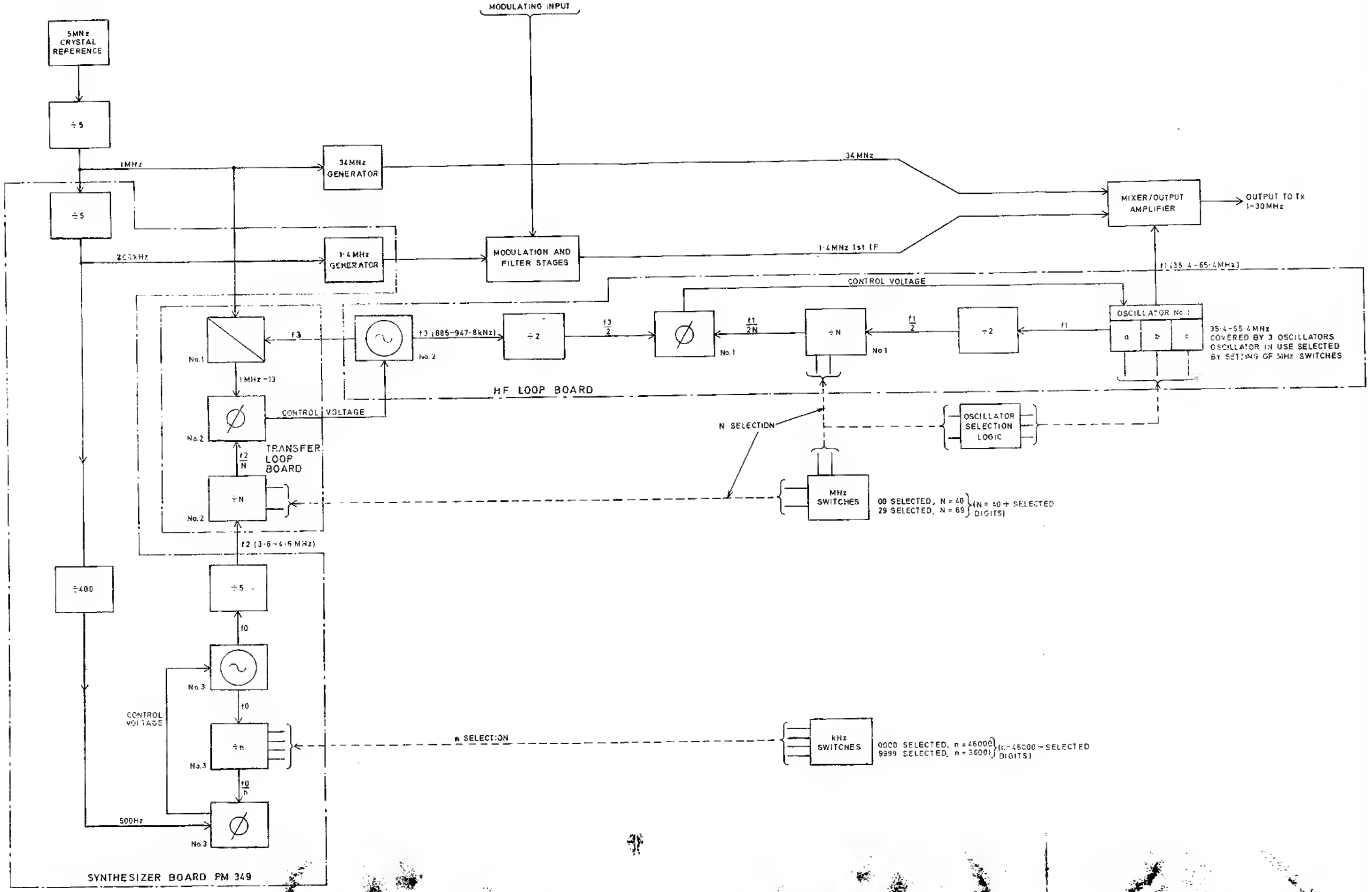
Cct. Ref.	Value	Description	Rat	Tal %	Racal Part Number	Manufacturer
		Crystals				
XL1		1.4MHz			AD75885	Racal
XL1		1.4MHz			AD75885	Racal
		Ferrite Beads				
FB1					900461	Mullard FX1115



WOH2085

M.A.1720: Simplified Block Diagram

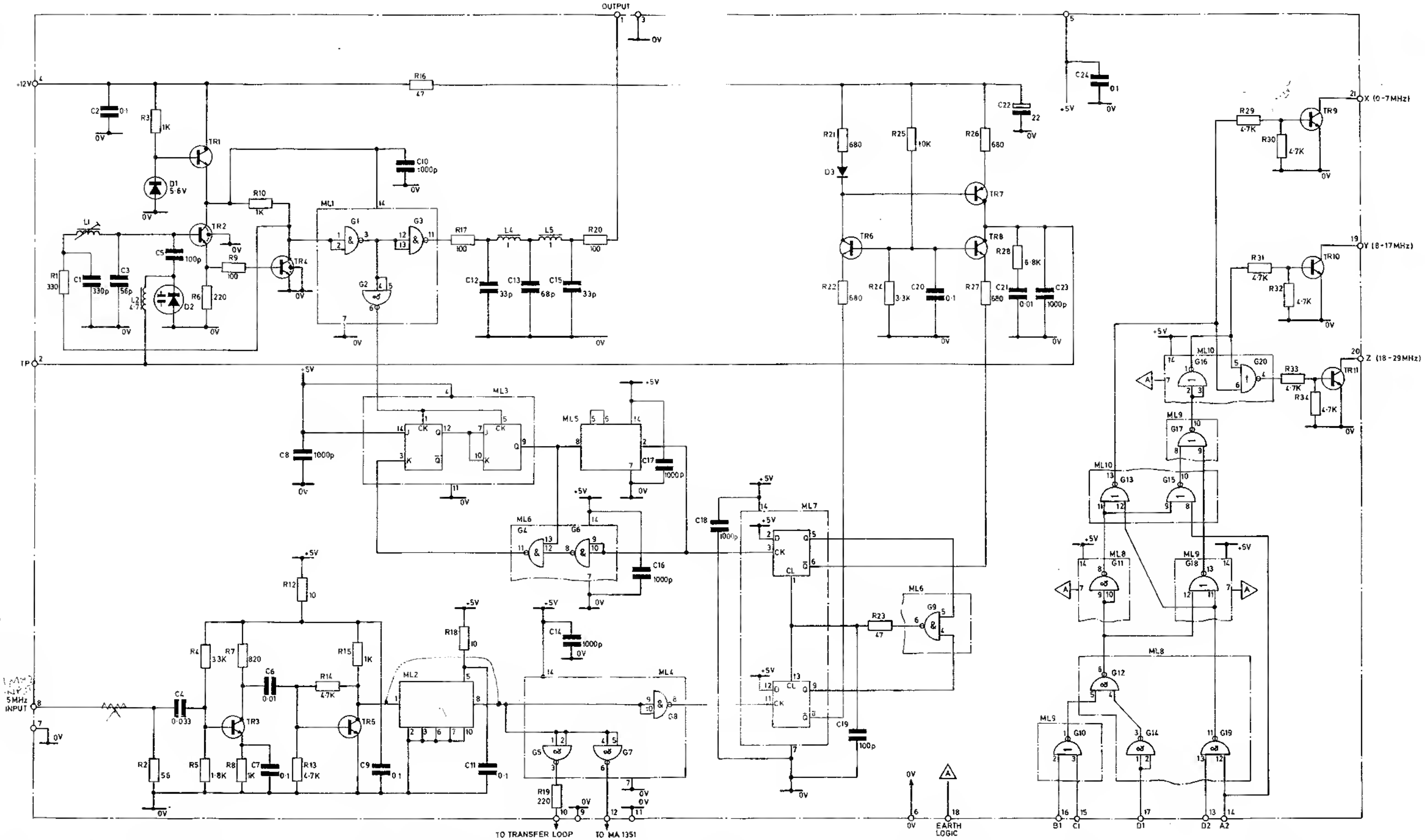
Fig 1



WOH2085

Frequency Synthesis Drive Unit M.A.1720

Fig2



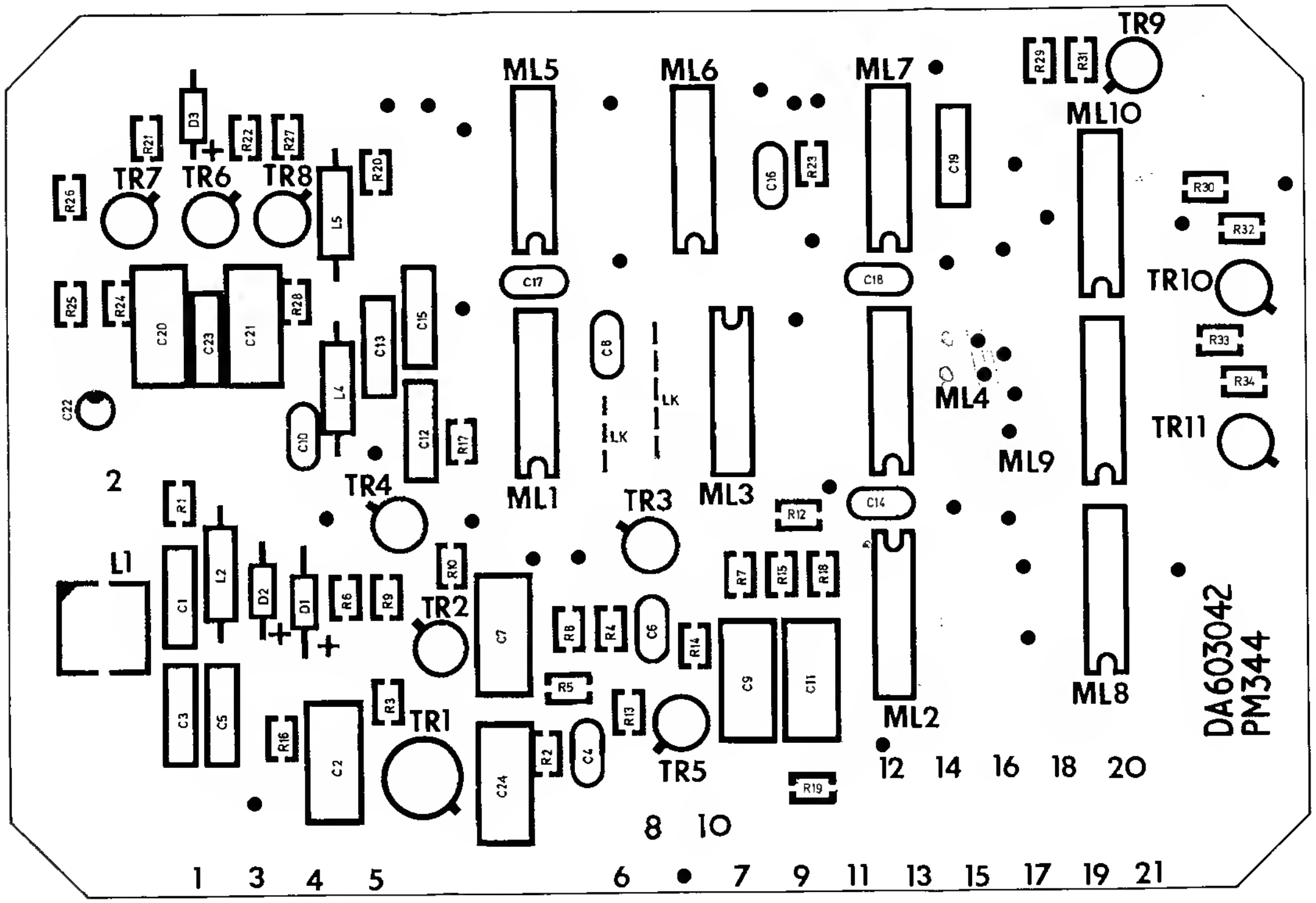
WOH 2085 | DC 603042
1 | 2

470Ω RESISTOR FITTED AT CTS.

+5% BYPASSED.

Circuit: 34 MHz Generator PM 344

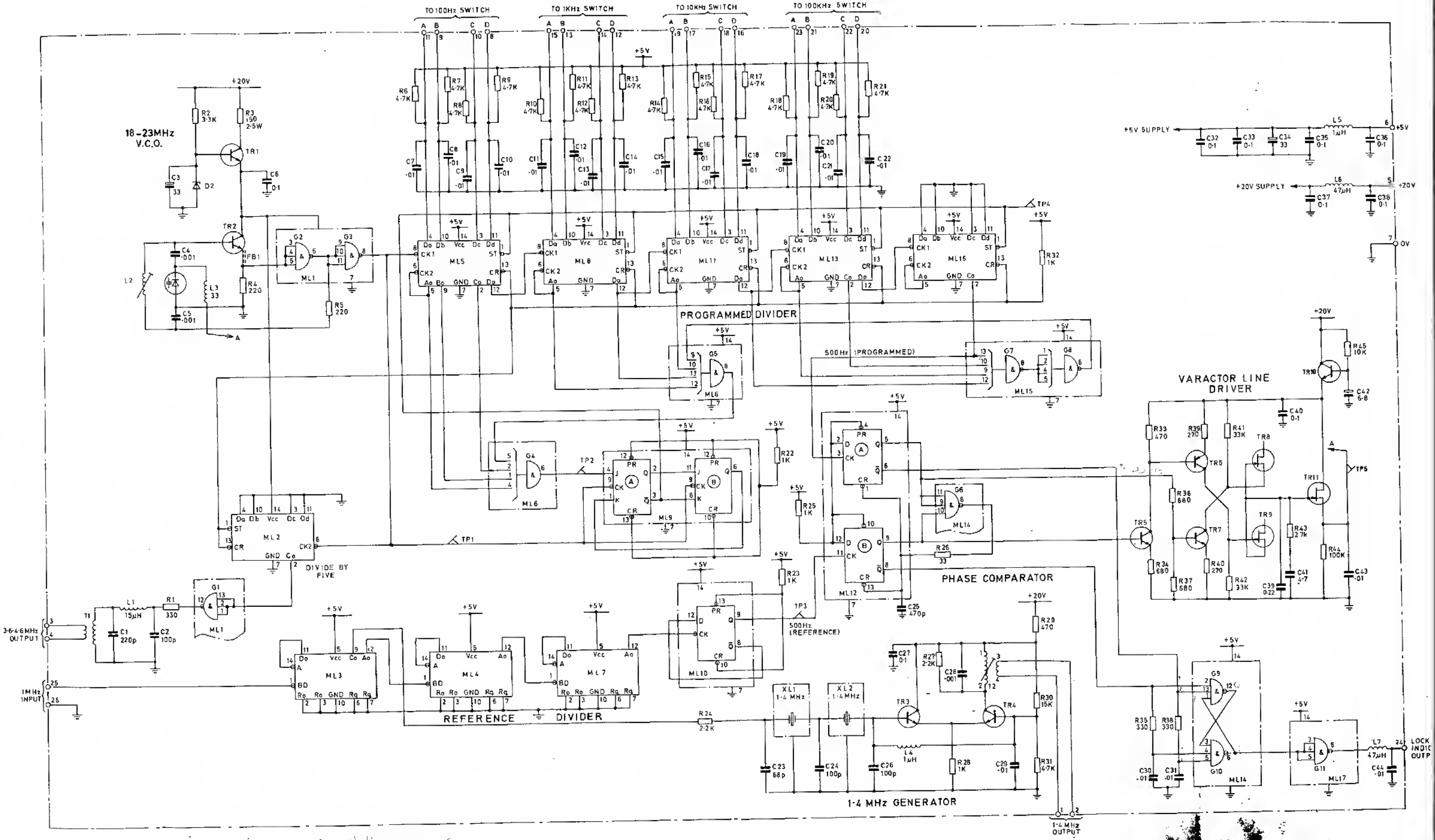
PM344
Fig. 3



WOH2085	DA603042 SHT 1
C	2

Layout: 34MHz Generator Board PM344

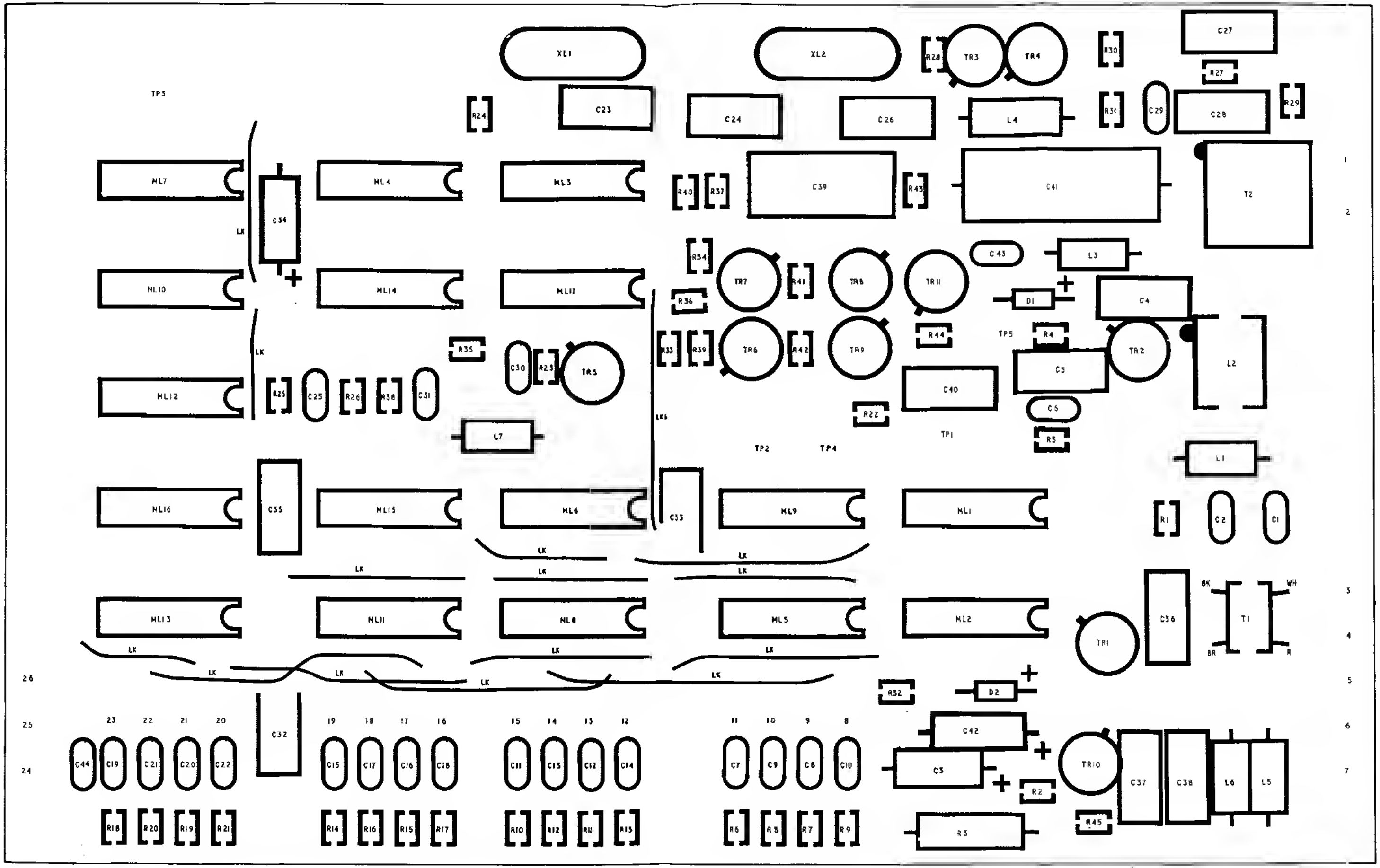
Fig. 4



WOH2085	DC76483
0	2

Circuit : Frecuency Synthesiser PM349

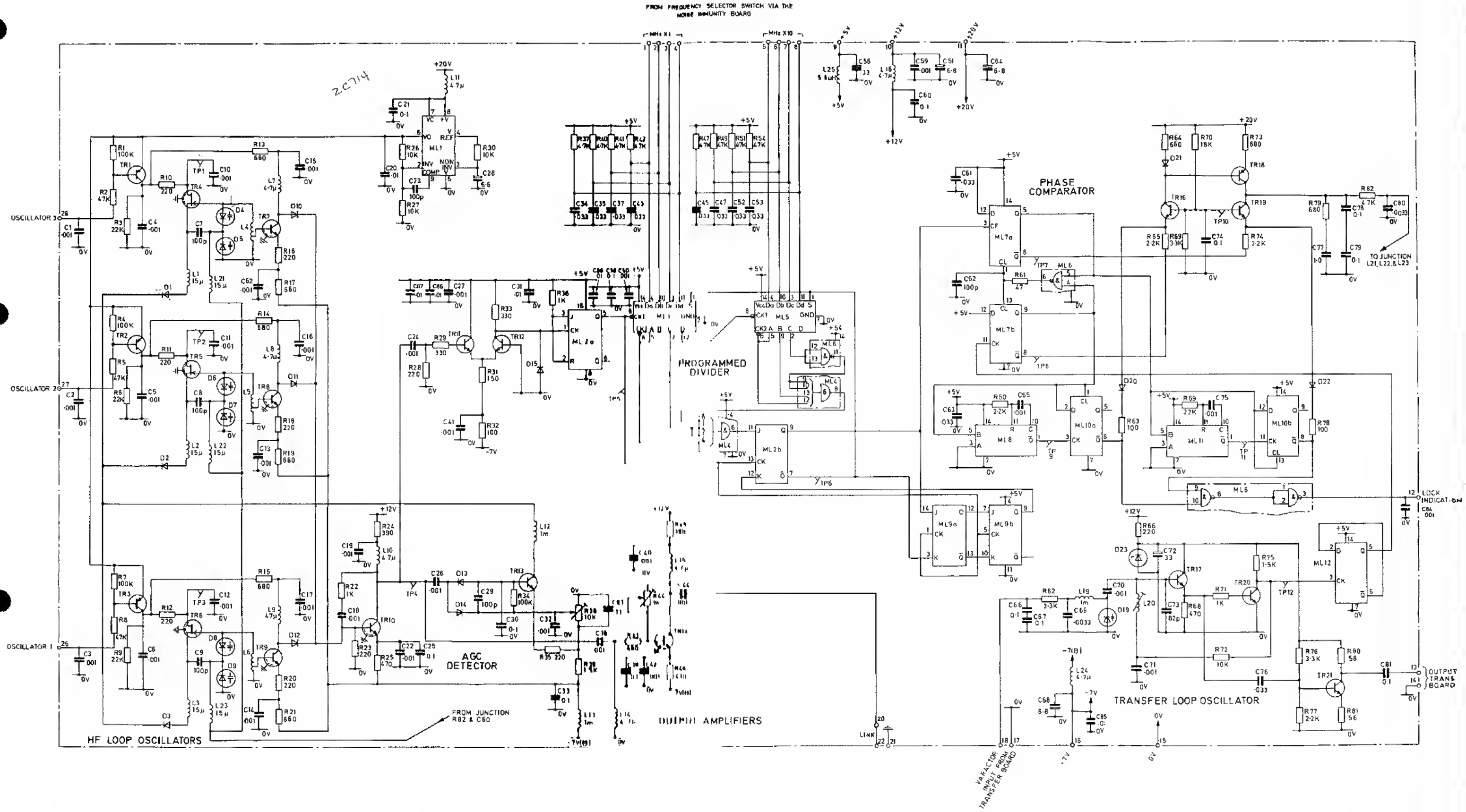
Fig. 2·3·5



WOH2085 DA764B3
B 2

Layout: Frequency Synthesizer Board PM349

Fig. 6

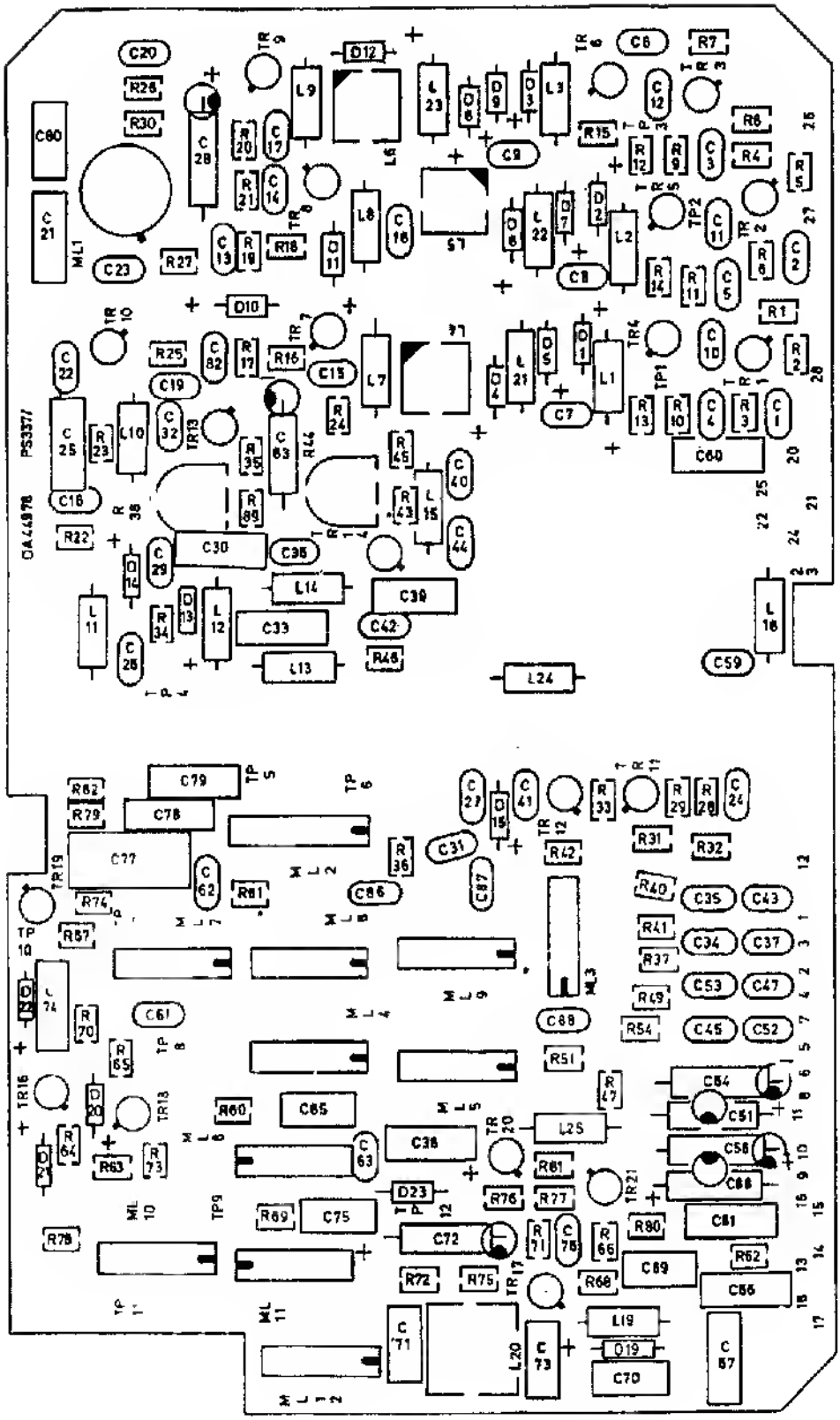


WOH2085 | EC44978
C | 2

Circuit: HF Loop Board PS 337/3

Fig. 7

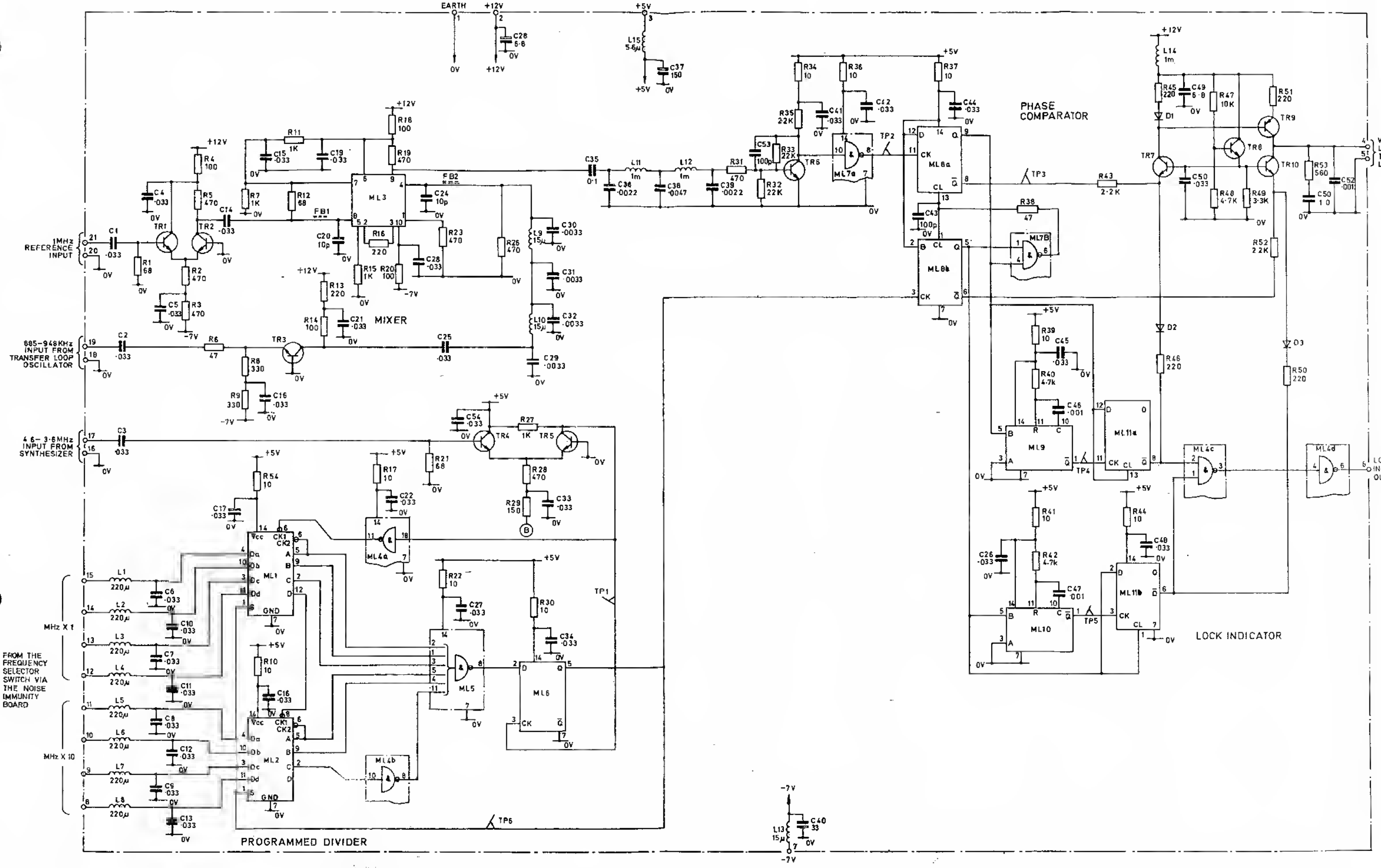
PS337/3



WOH2085 OA44978
3

Layout : H.F. Loop Board PS337

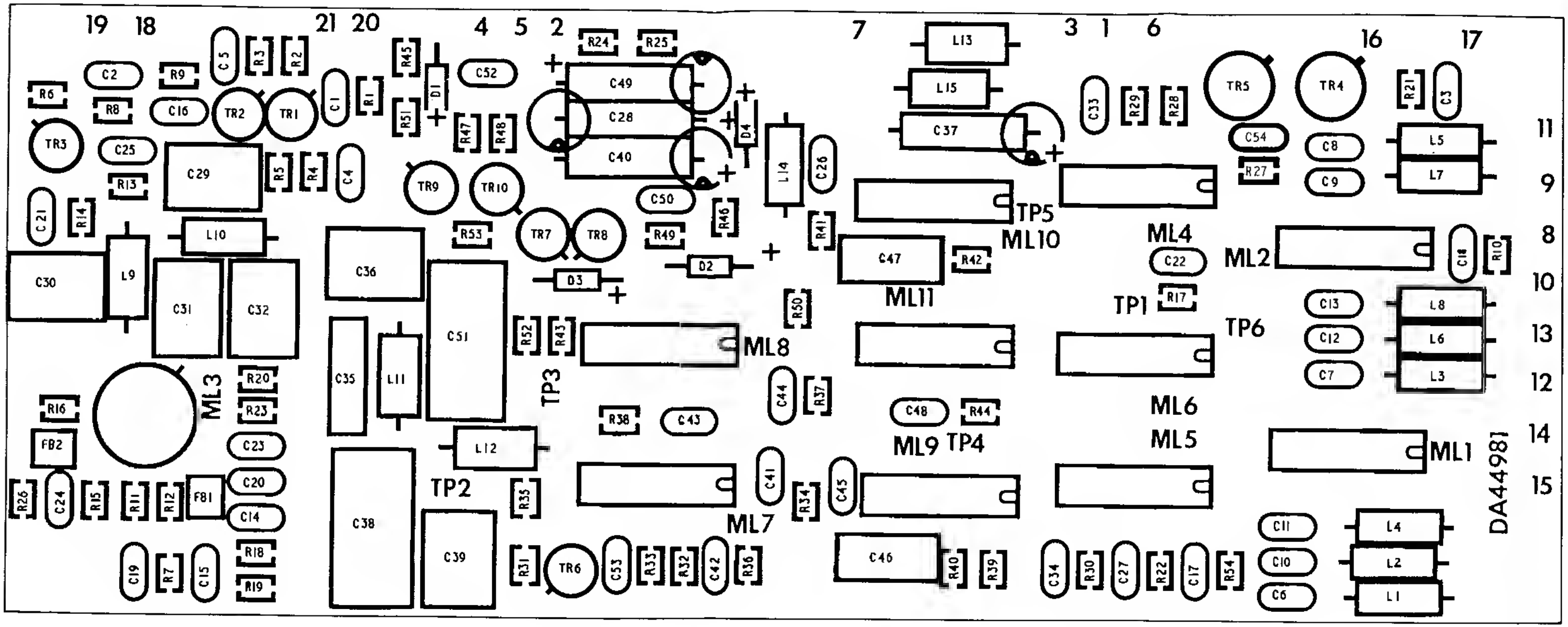
Fig. 8



WOH2085 DC4498
C 2

Circuit: Transfer Loop PS338

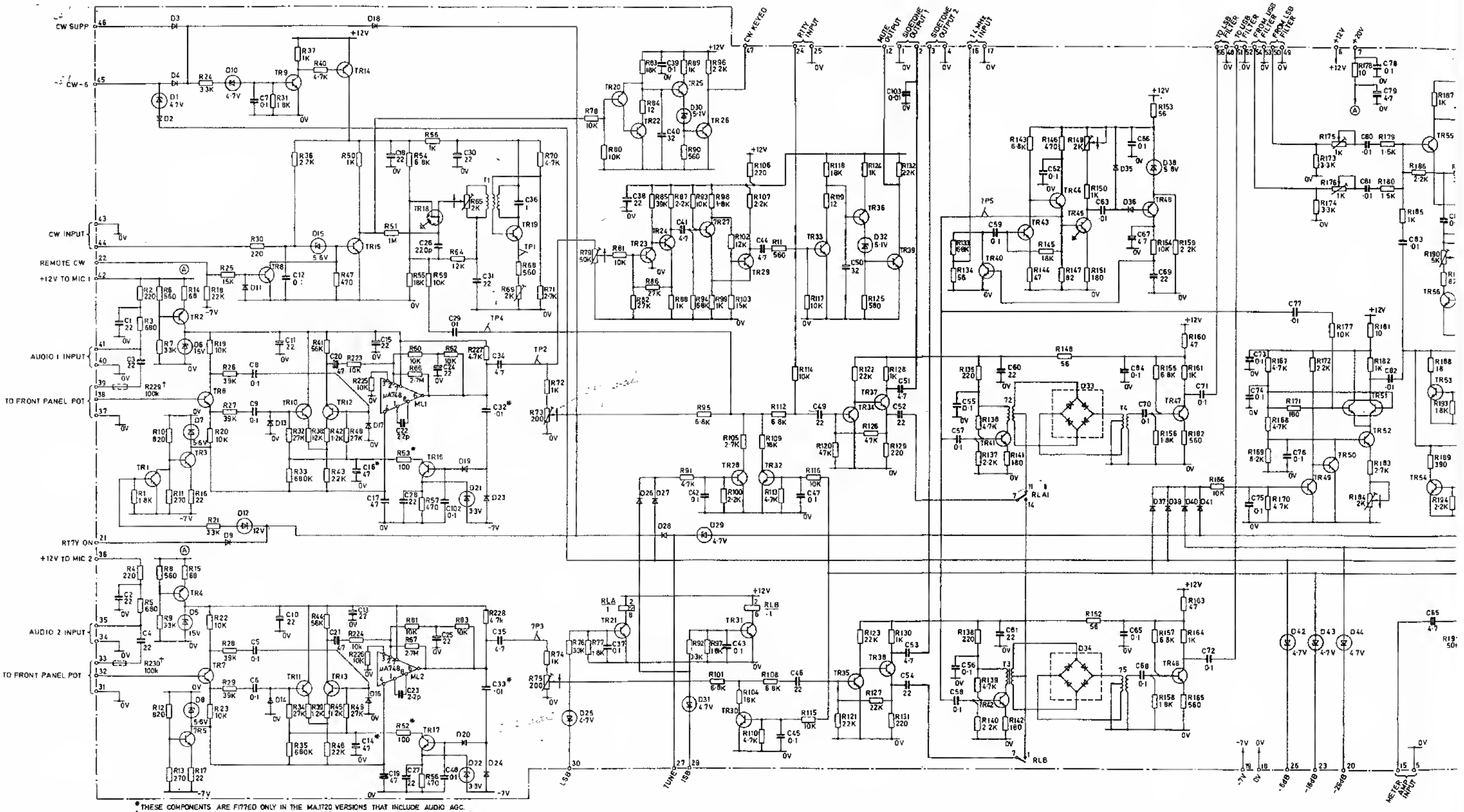
Fig 9



WOH2085 DA44961/A
3

Layout: Transfer Loop Board PS338

Fig. 10

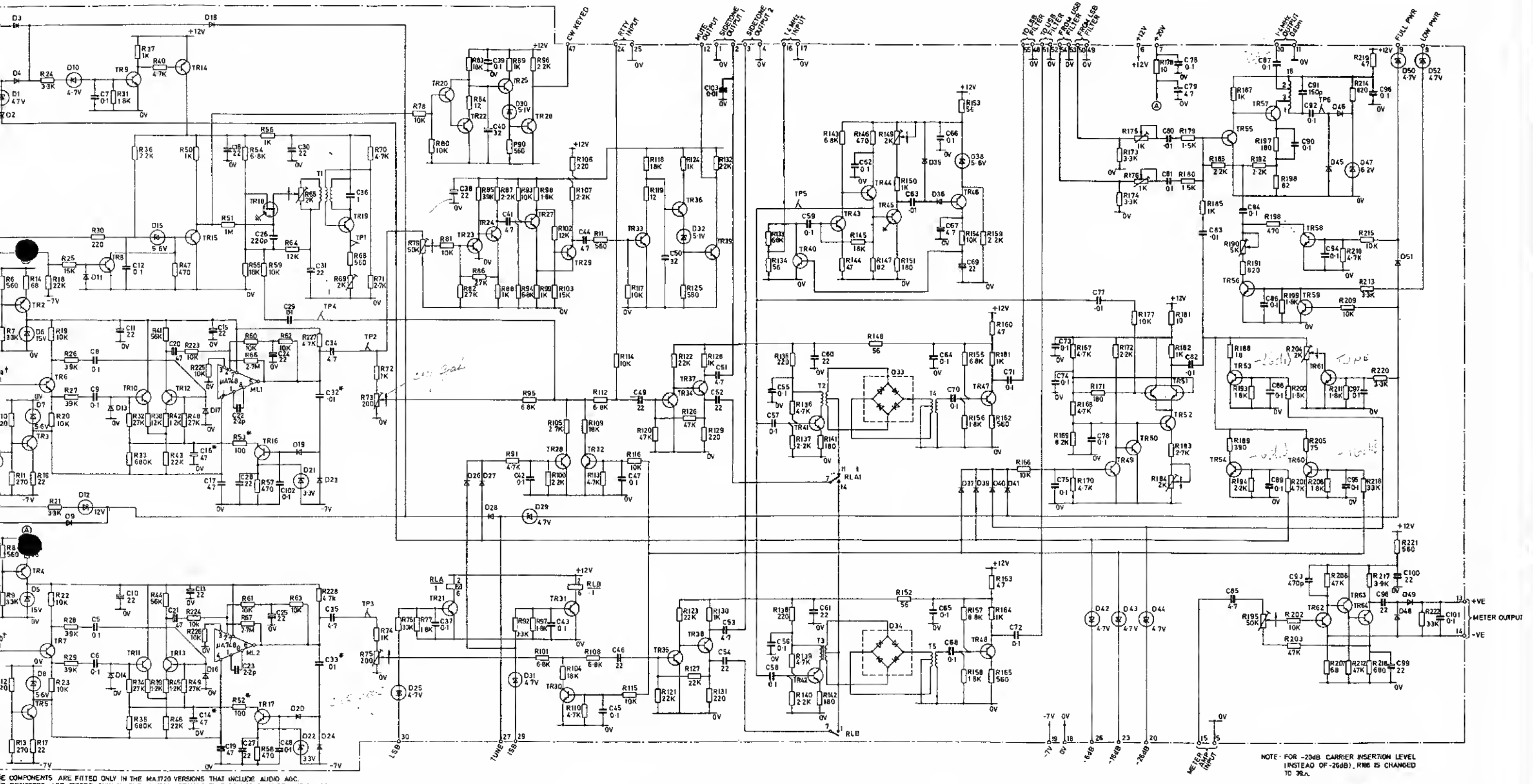


* THESE COMPONENTS ARE FITTED ONLY IN THE MA1720 VERSIONS THAT INCLUDE AUDIO AGC.
† THESE RESISTORS ARE FITTED ONLY IN THE MA1720 VERSIONS THAT DO NOT INCLUDE AUDIO AGC.

WOH 2085	EC603030
B 2 3	

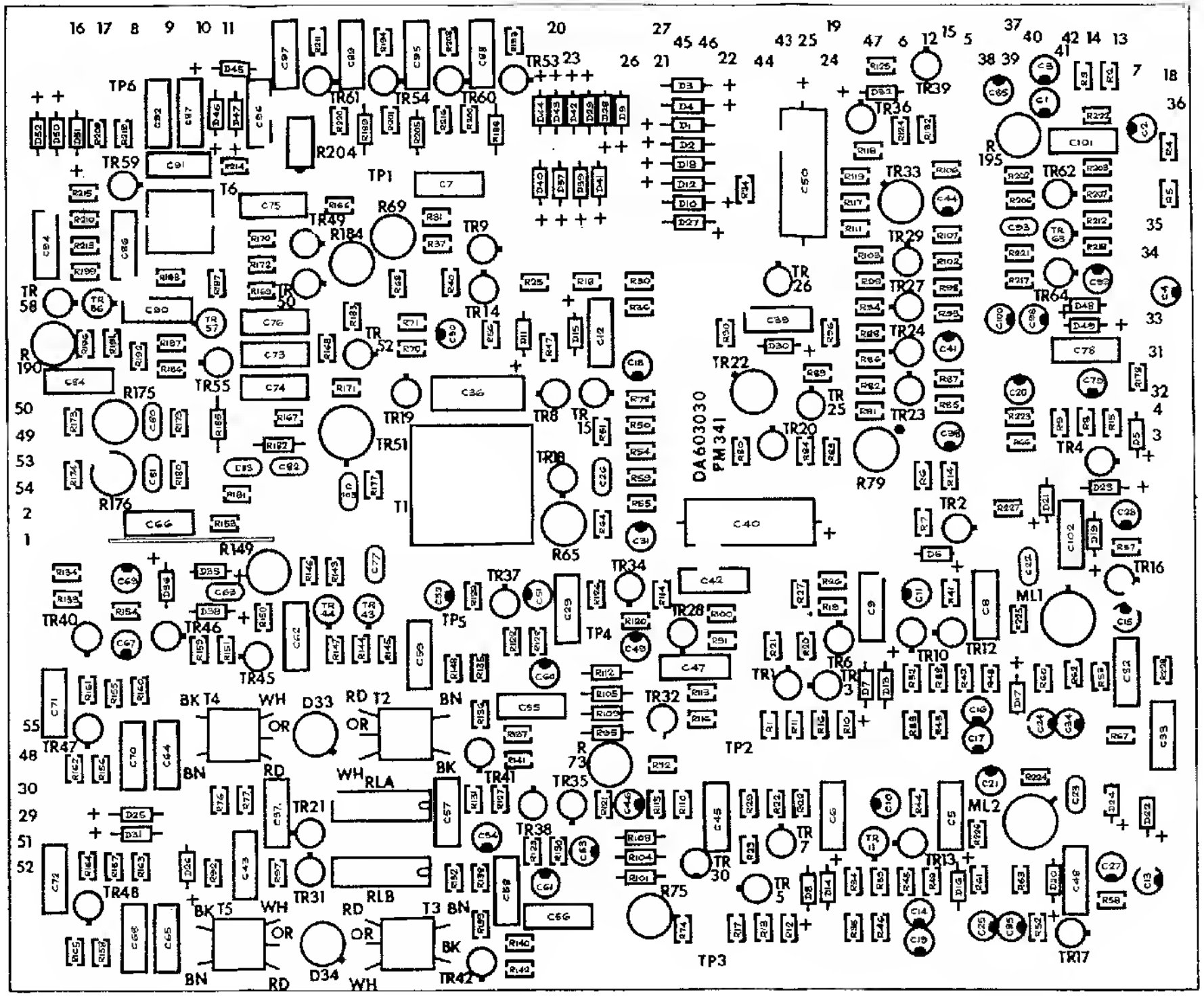
Circuit: Low Level PCB PM341

Fig 11 (Part i)



Circuit: Low Level PCB PM341

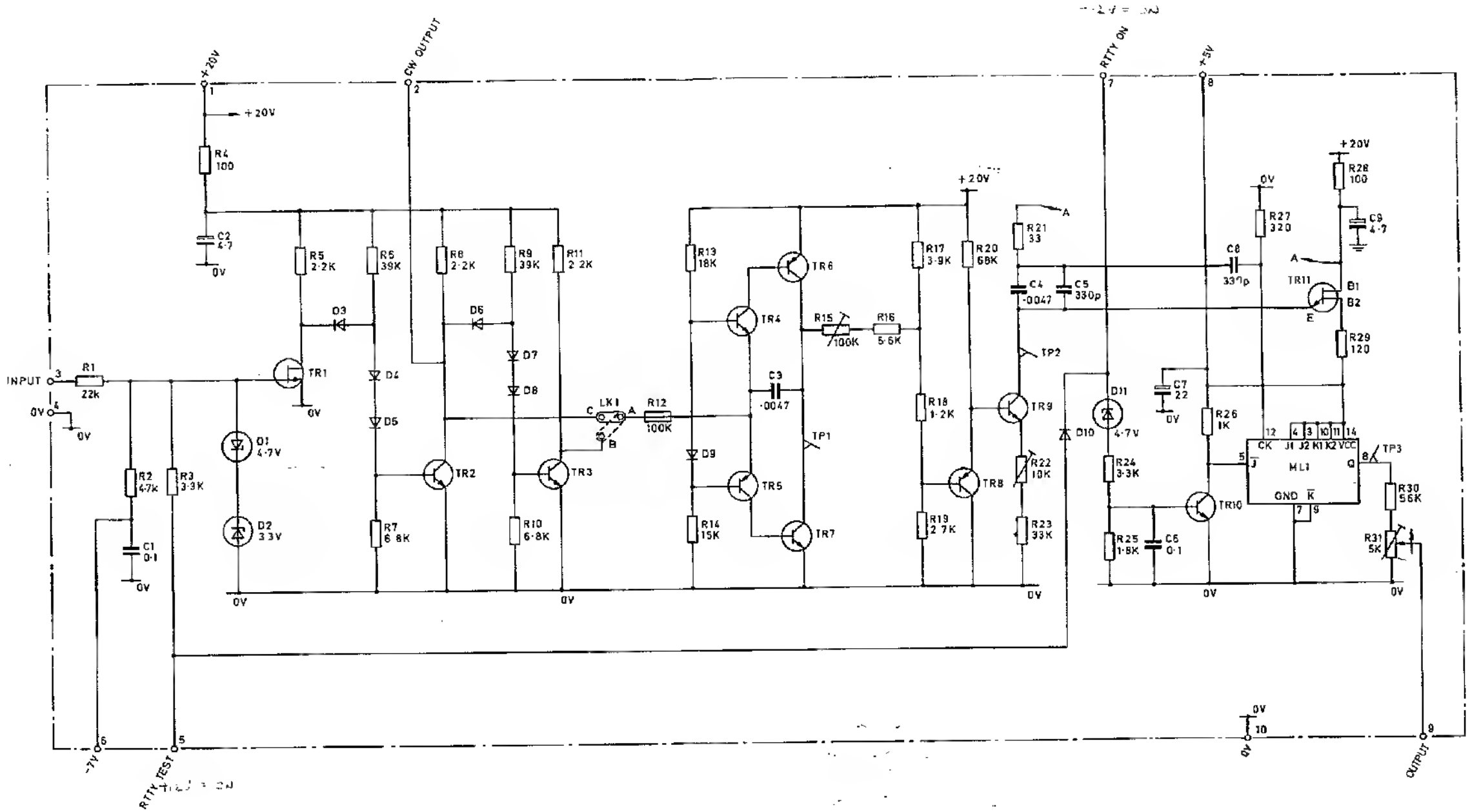
Fig.11
(Part ii)
PM341



WOH 2085	DA603030_SHT1
	2

Layout: Low Level Board (PM341)

Fig. 12

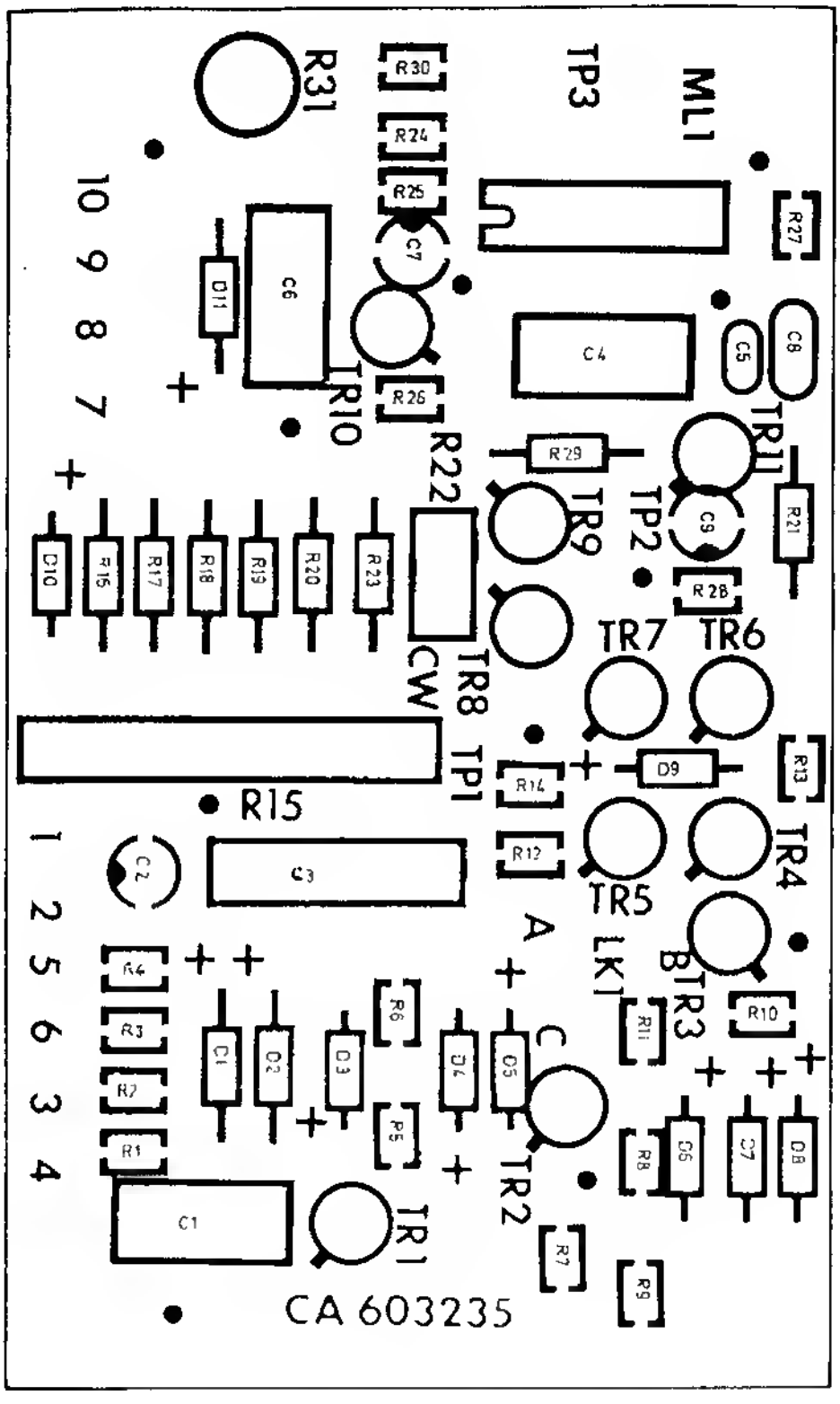


NOTE : LINK A-B FOR NORMAL KEYING
LINK A-C FOR REVERSE KEYING

WOH 2065	DC603235
A	1

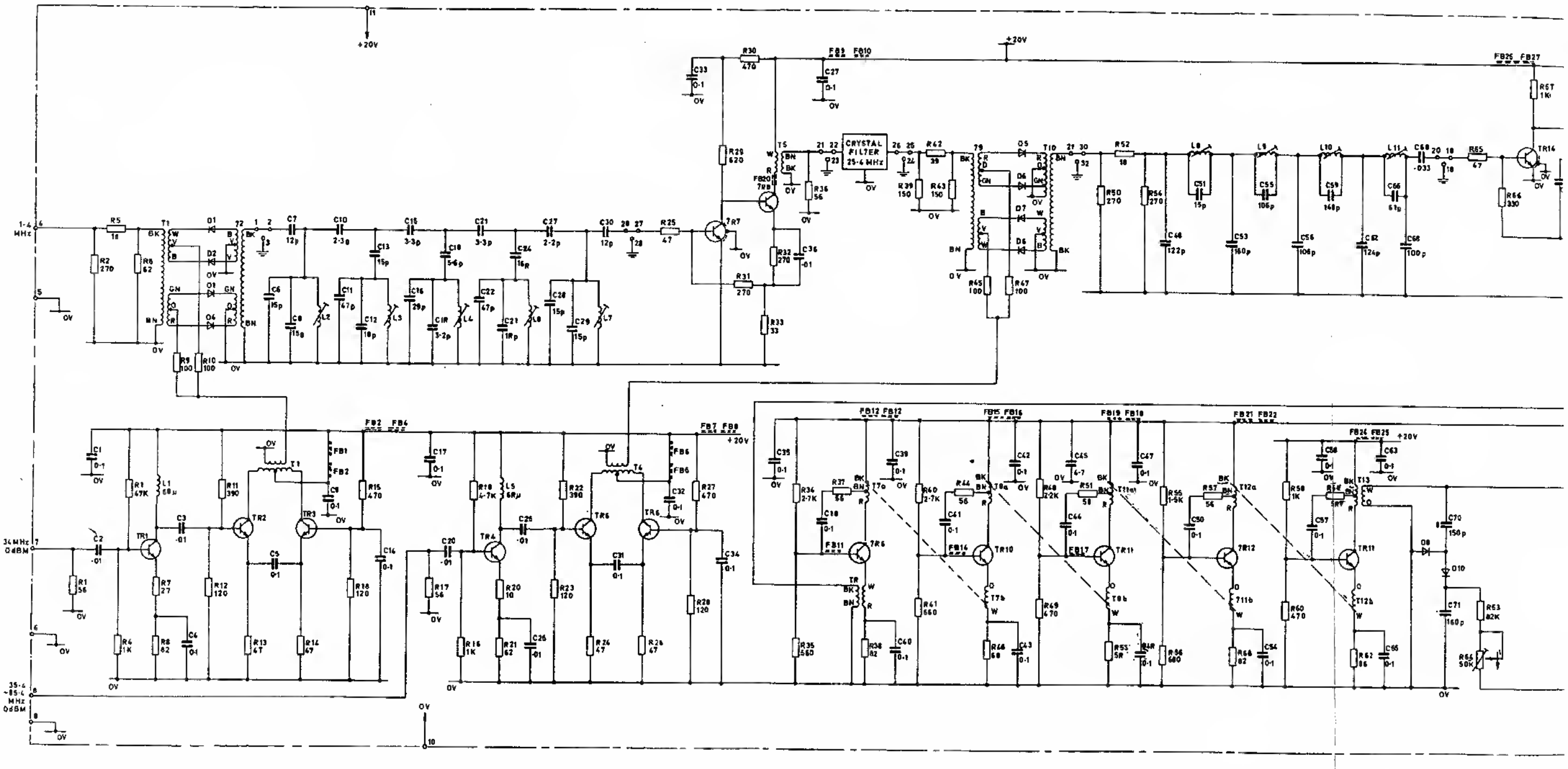
Circuit : RTTY Generator PM340

PM3
Fig.
13



WOH2085	CA603235
B	1

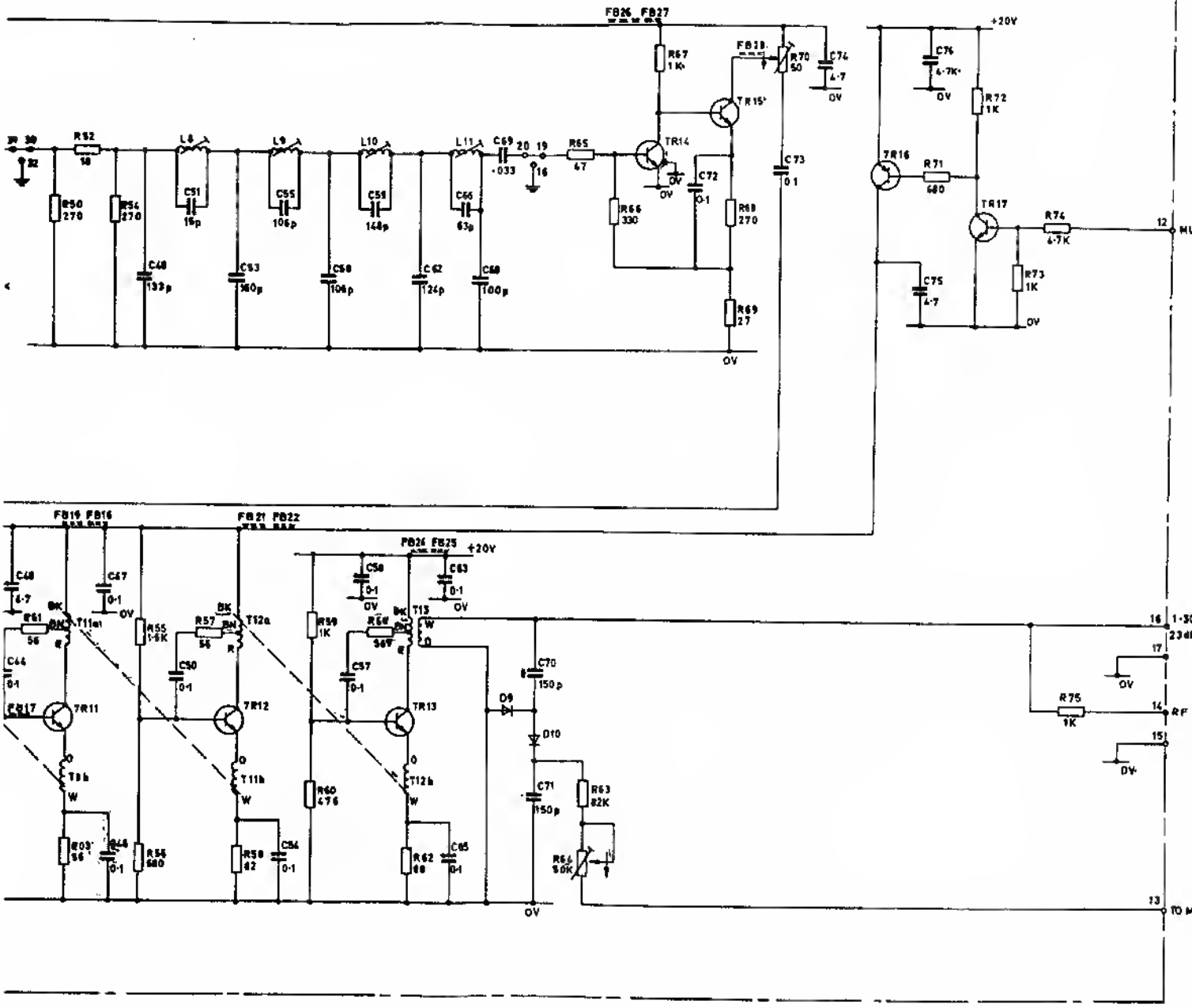
Layout: RTTY Generator Board PM340 Fig. 1



WOH 2085	EC 603036
B	1

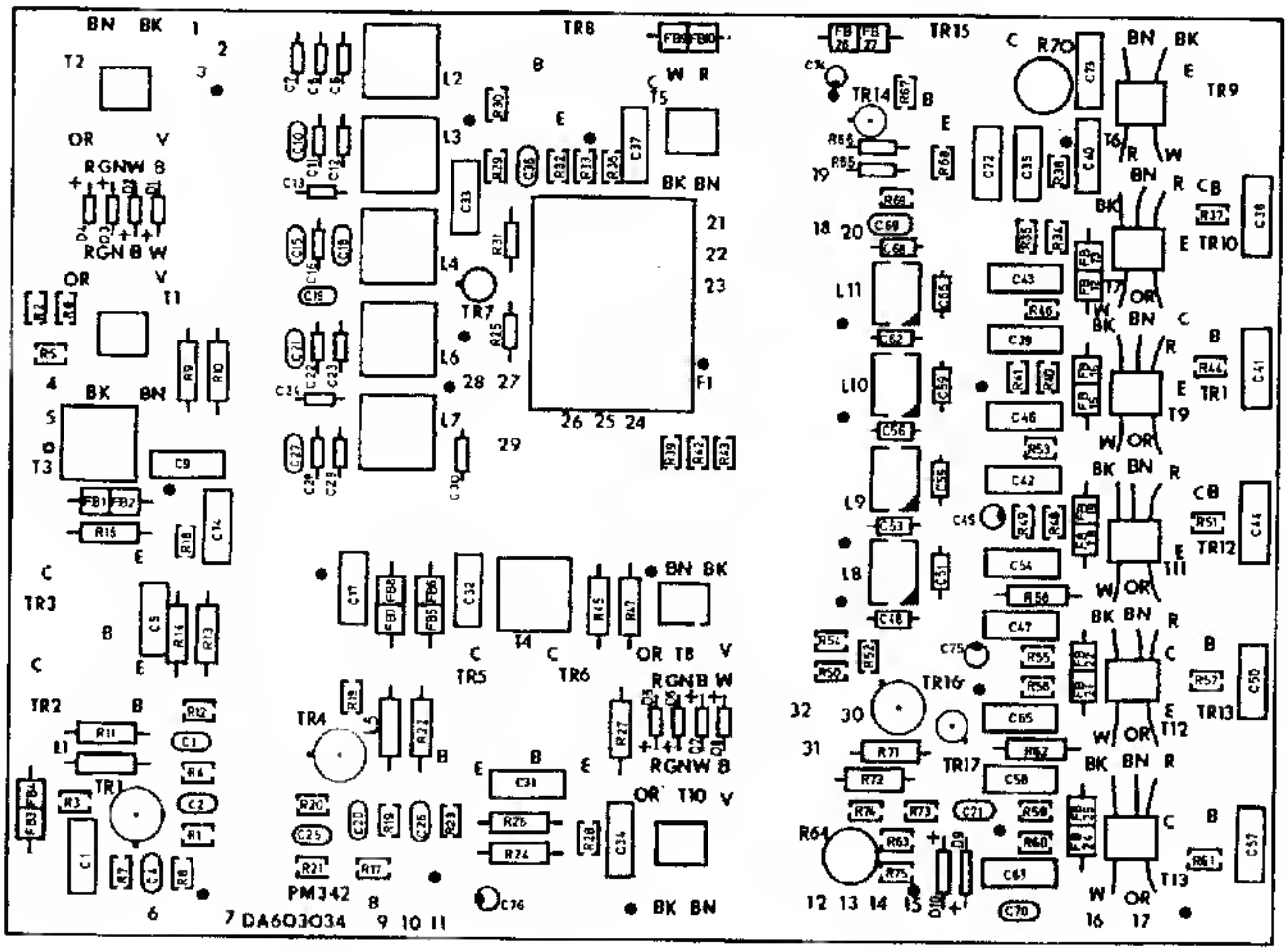
Circuit : Mixer and Output PCB PM342

Fig. 15 (Part 1)



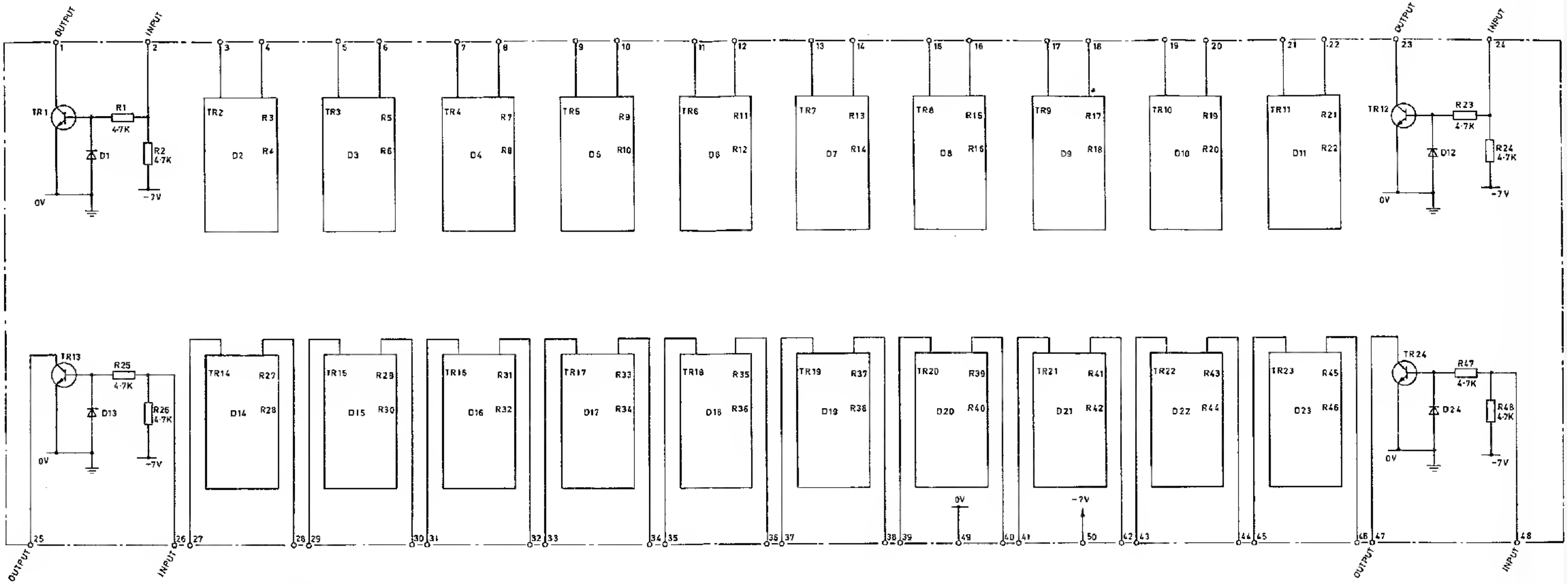
t PCB PM342

Fig
15
(Part



WOH2085 | DA603034
B

Layout: Mixer and Output P.C.B. PM342 Fig. 16

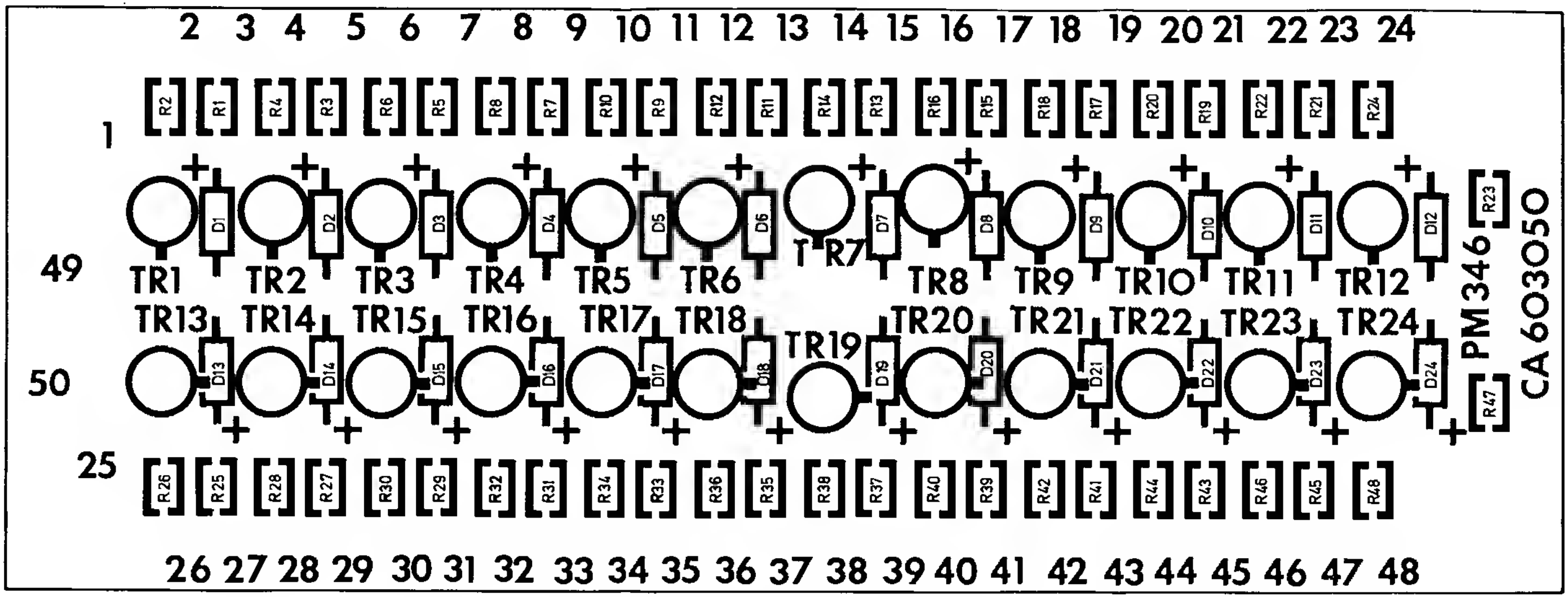


NOTE. EVEN NUMBERED PINS ARE INPUTS
ODD NUMBERED PINS ARE OUTPUTS

WOH 2085 | DC 603050
B | 1

Circuit : Noise Immunity PCB PM346

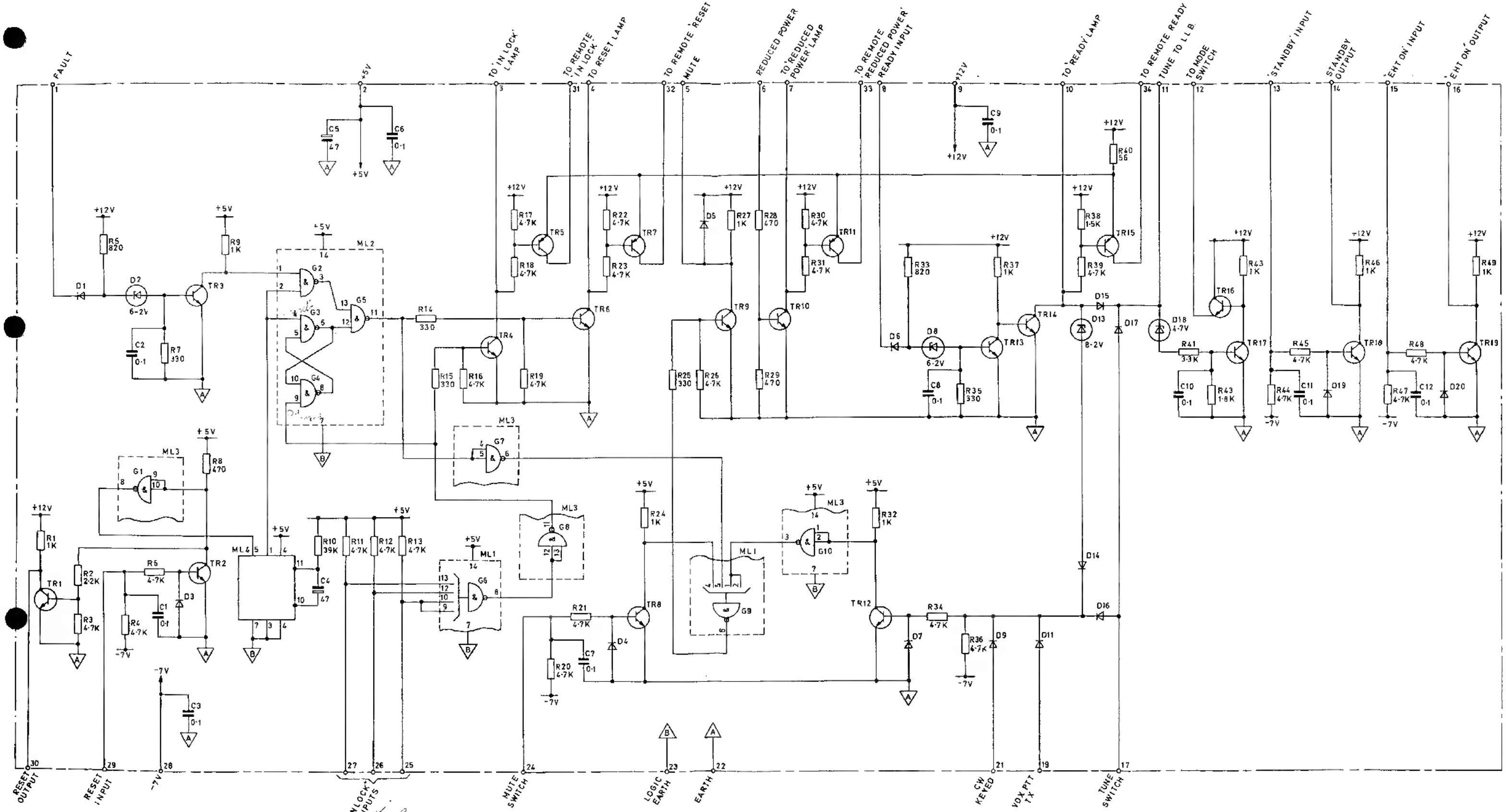
PM3
Fig.
17



/OM2085 | CA603050
1

Layout: Noise Immunity Board PM346

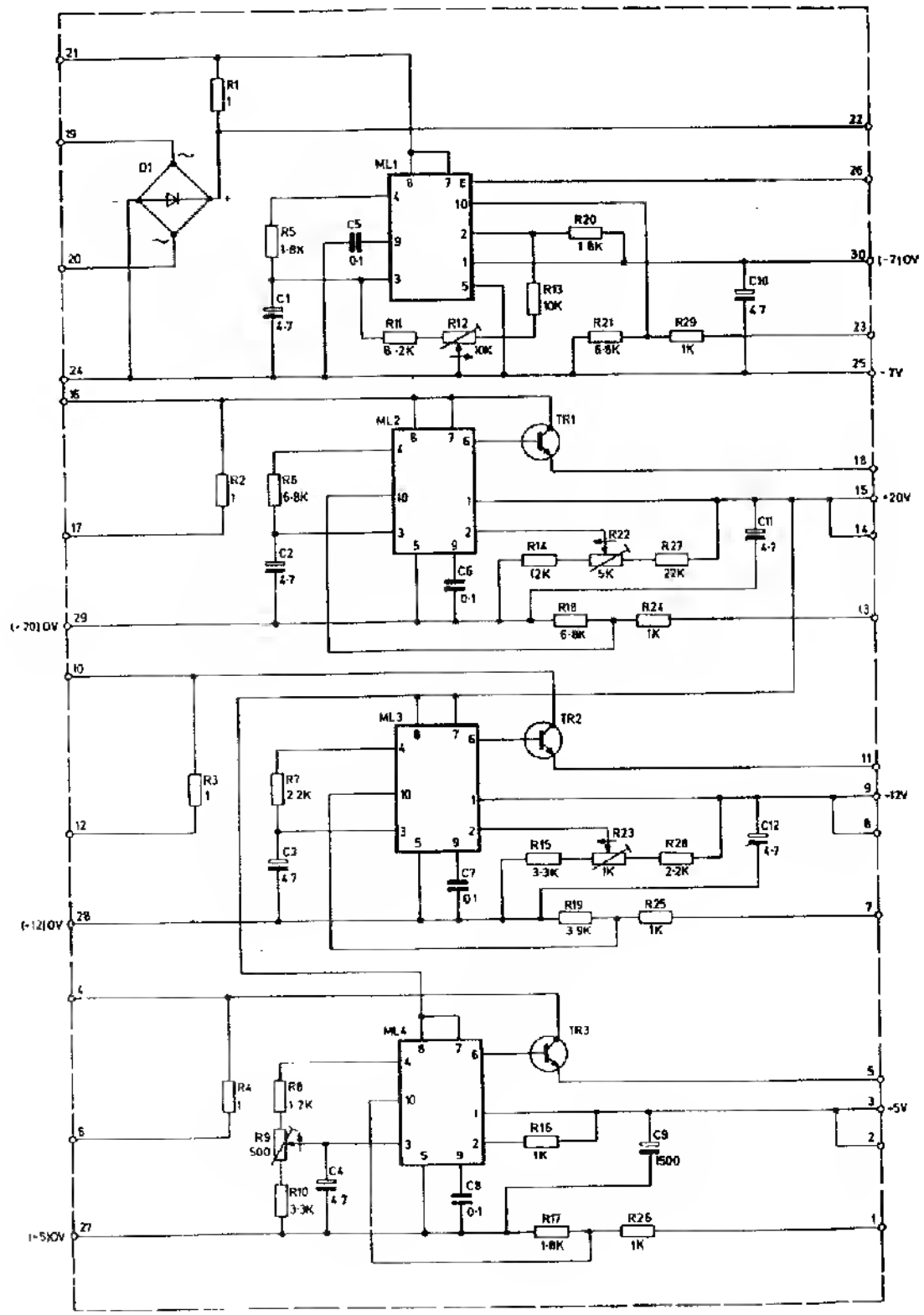
Fig. 18



OH 2085	EC603046
A	2

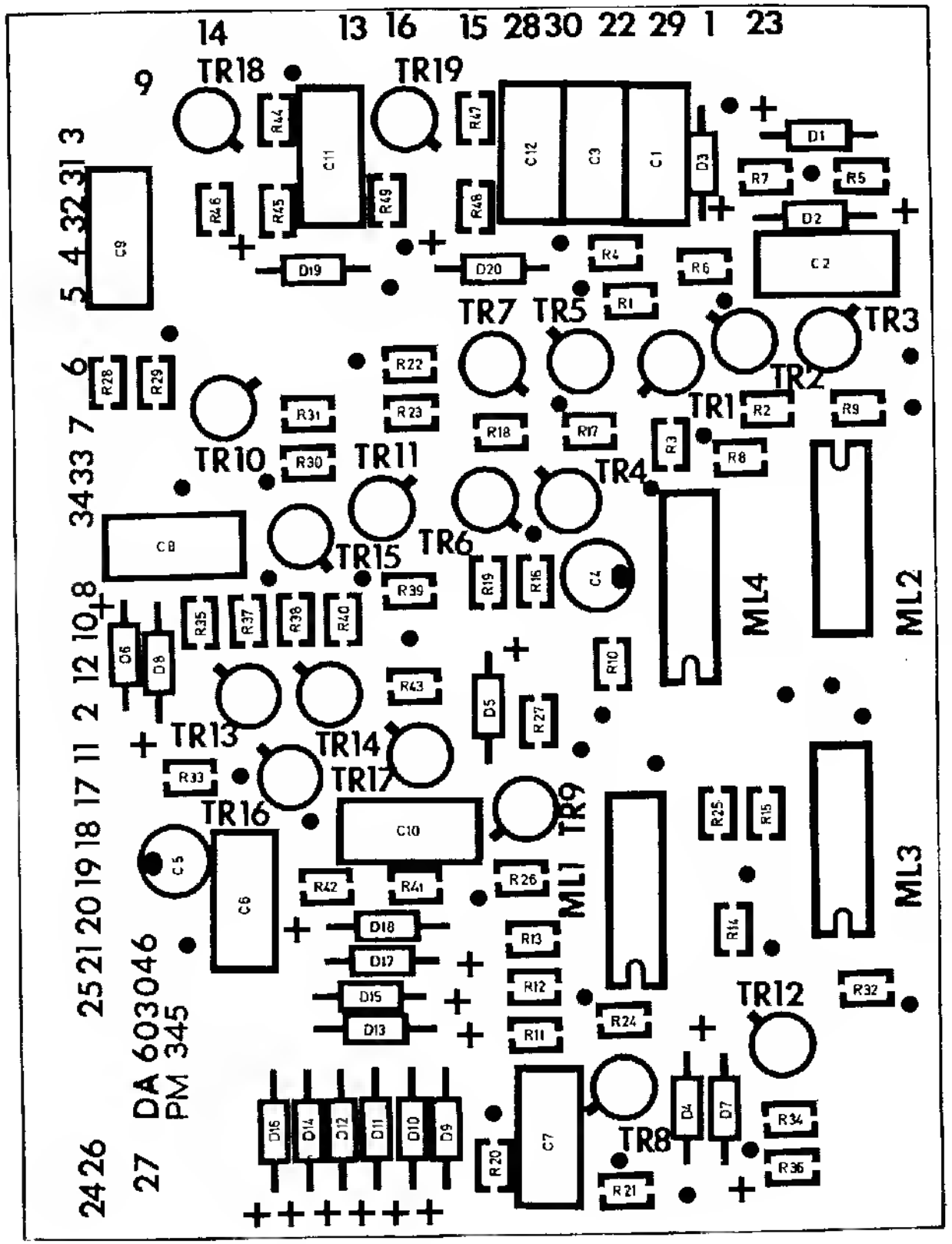
Circuit : Control PCB PM345

PM345
Fig.19



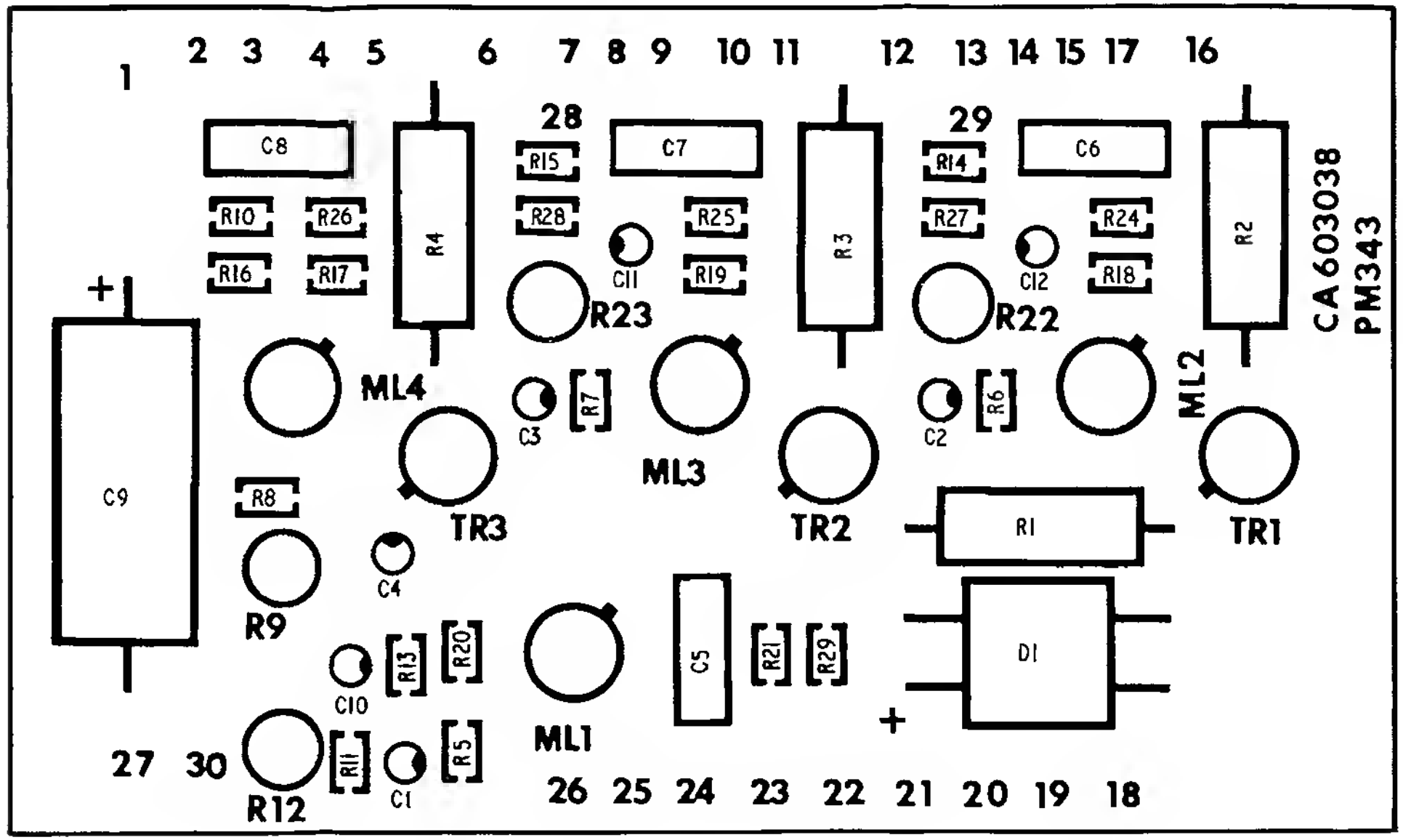
WOH2085 | CC603038
C

Circuit: Power Supply P.C.B. PM343 **Fig. 21**



WOH2085 | DA603046 SHT 1
B

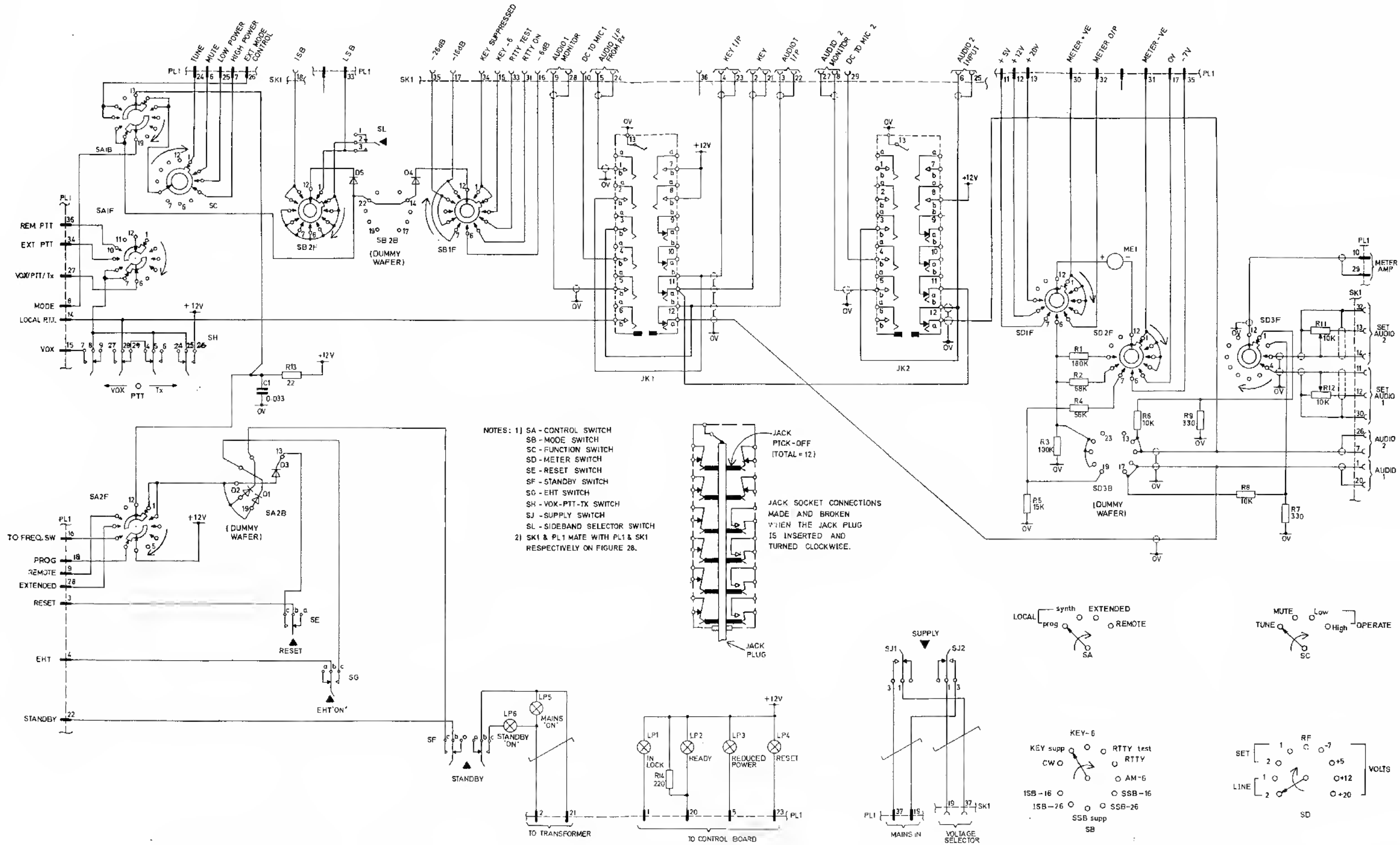
Layout: Control P.C.B PM345 **Fig. 20**



WOH2085	CA603038
B	1

Layout: Power Supply Board PM343

Fig. 22

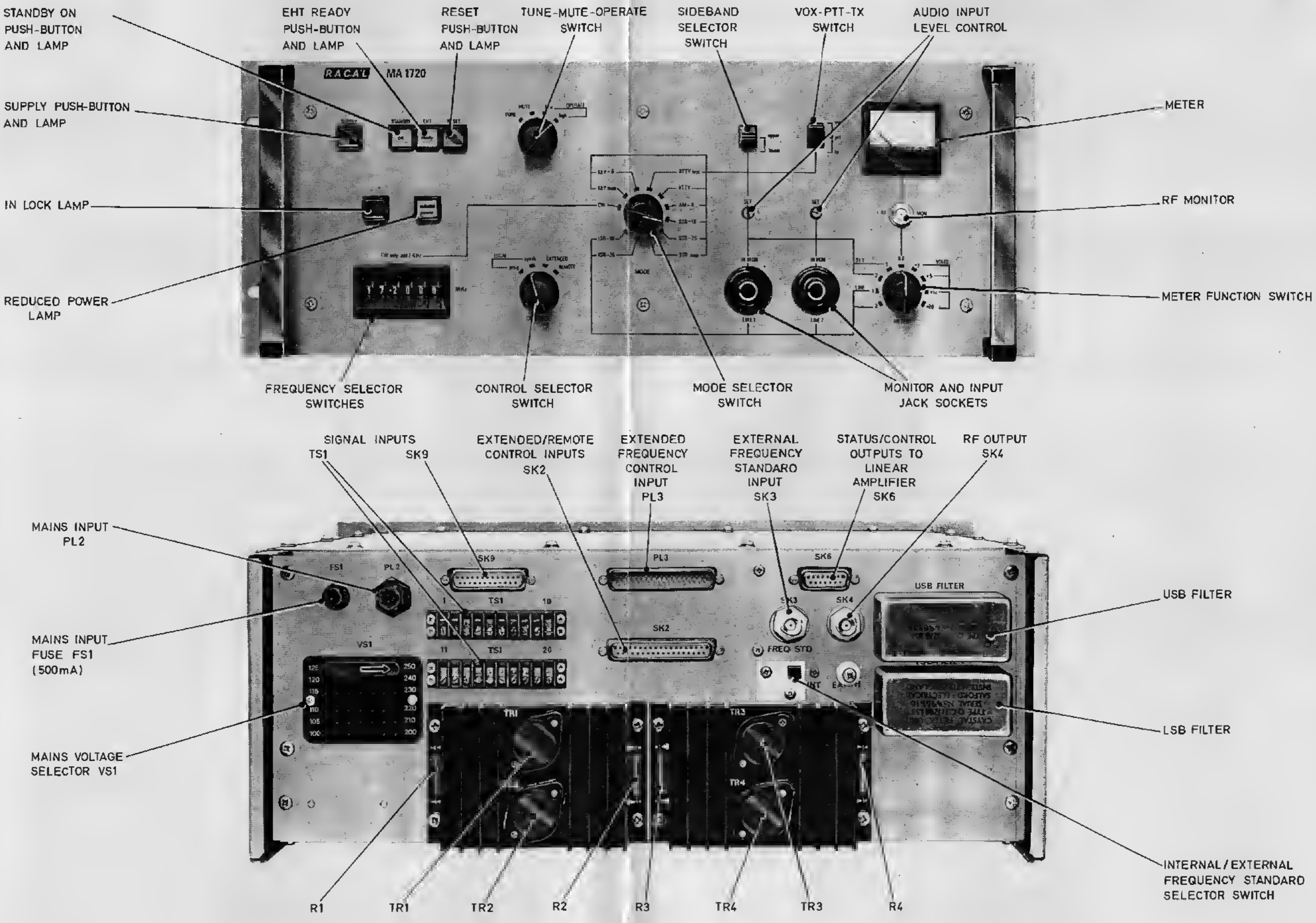


NOTES: 1) SA - CONTROL SWITCH
SB - MODE SWITCH
SC - FUNCTION SWITCH
SD - METER SWITCH
SE - RESET SWITCH
SF - STANDBY SWITCH
SG - EHT SWITCH
SH - VOX-PTT-TX SWITCH
SJ - SUPPLY SWITCH
SL - SIDEBAND SELECTOR SWITCH
2) SK1 & PL1 MATE WITH PL1 & SK1 RESPECTIVELY ON FIGURE 28.

WOH2065	DC603201
F	1

Circuit: Front Panel

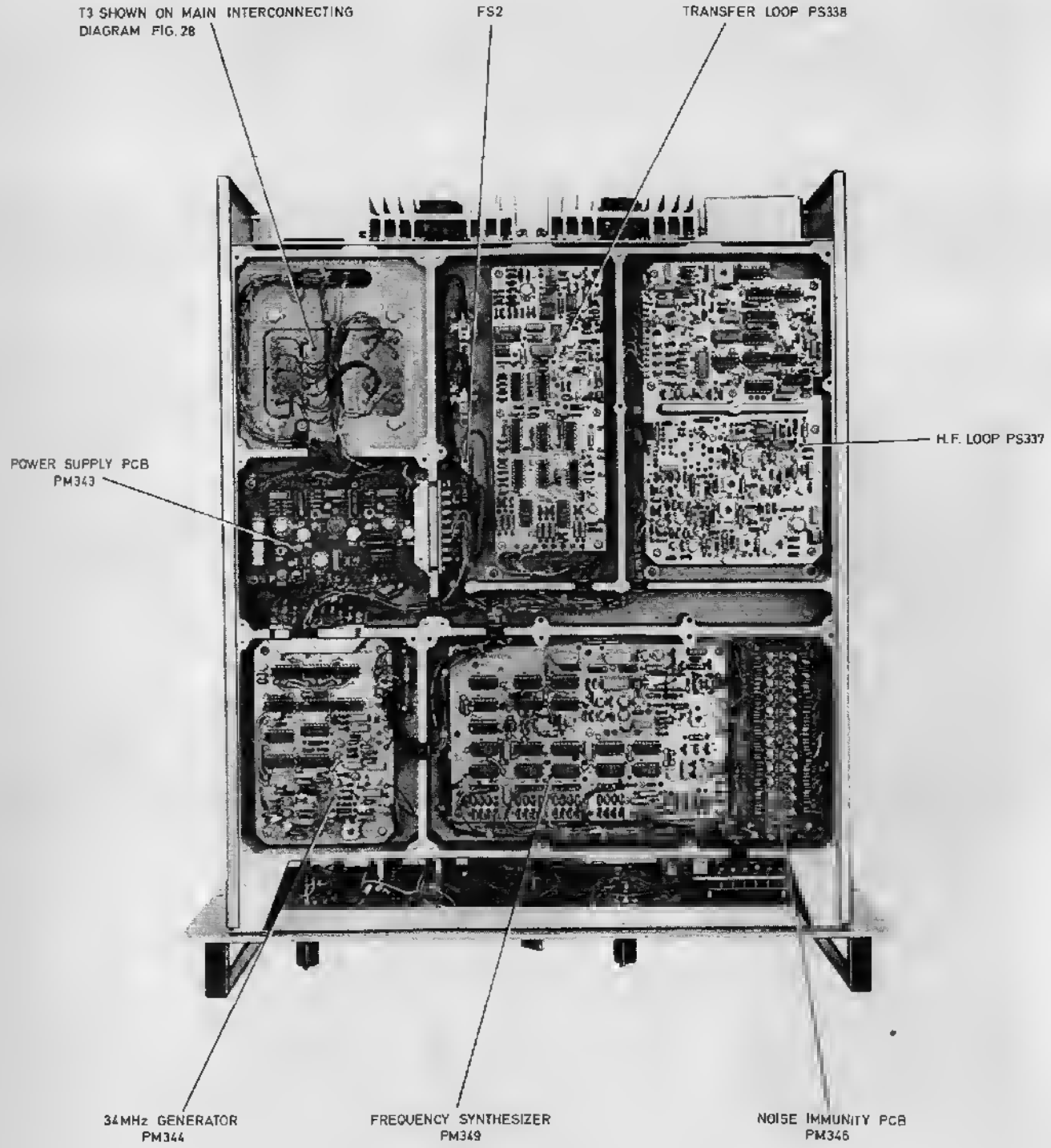
Fig. 23



WOH2085

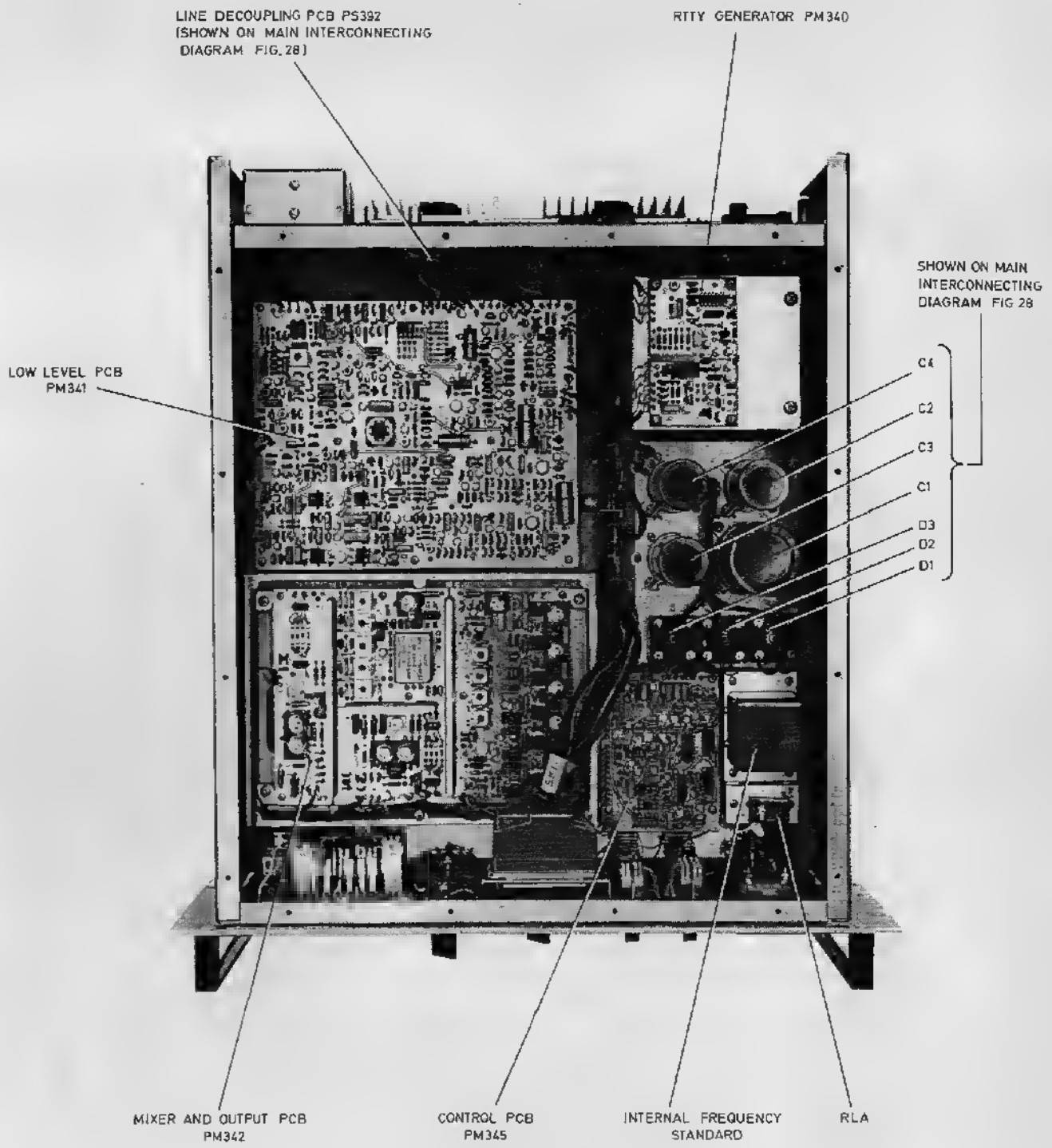
Front and Rear Panels - MA.1720

Fig. 2



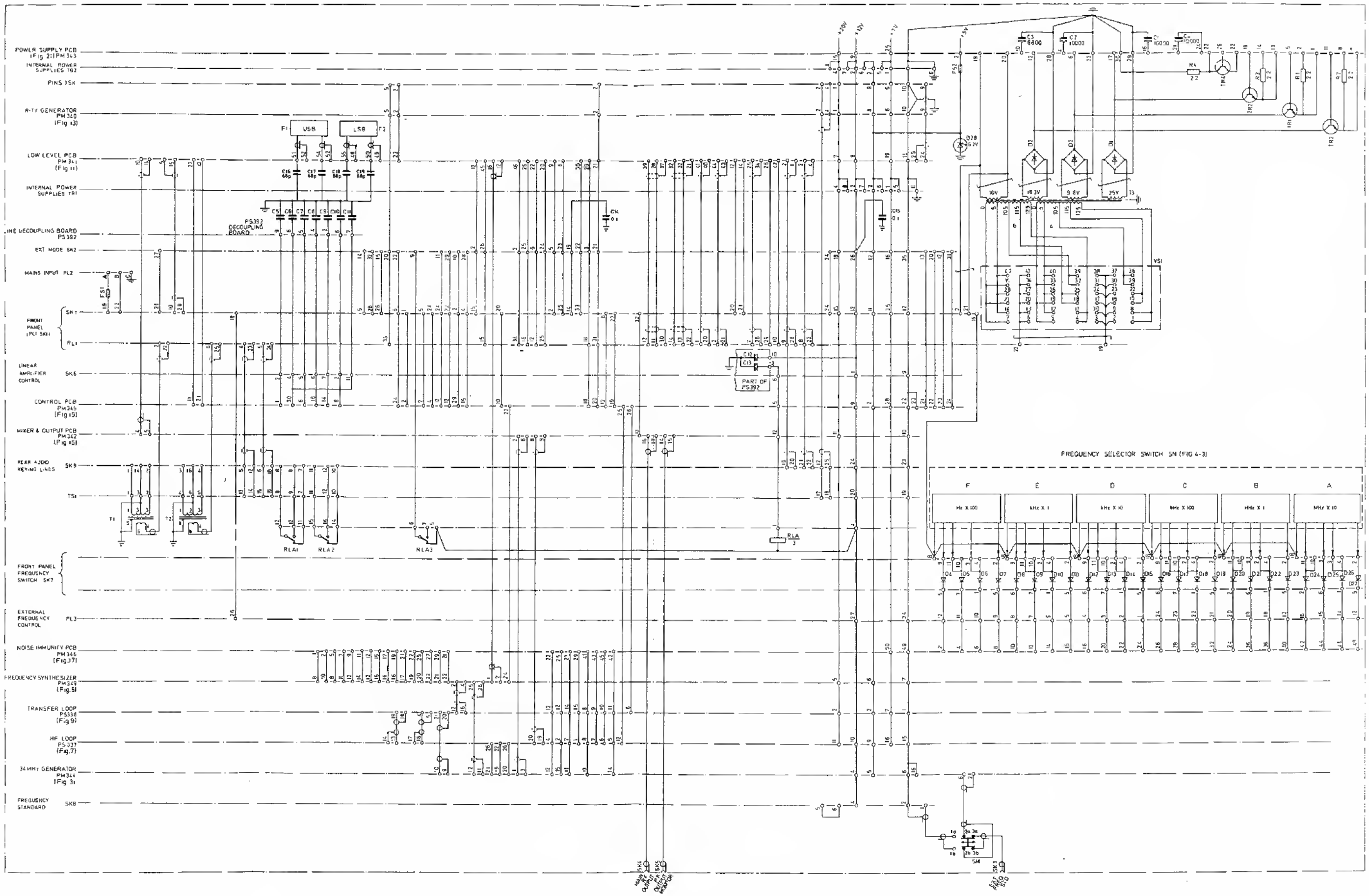
WOH2085

Component Layout : Chassis Underside Fig. 26



WOH2085

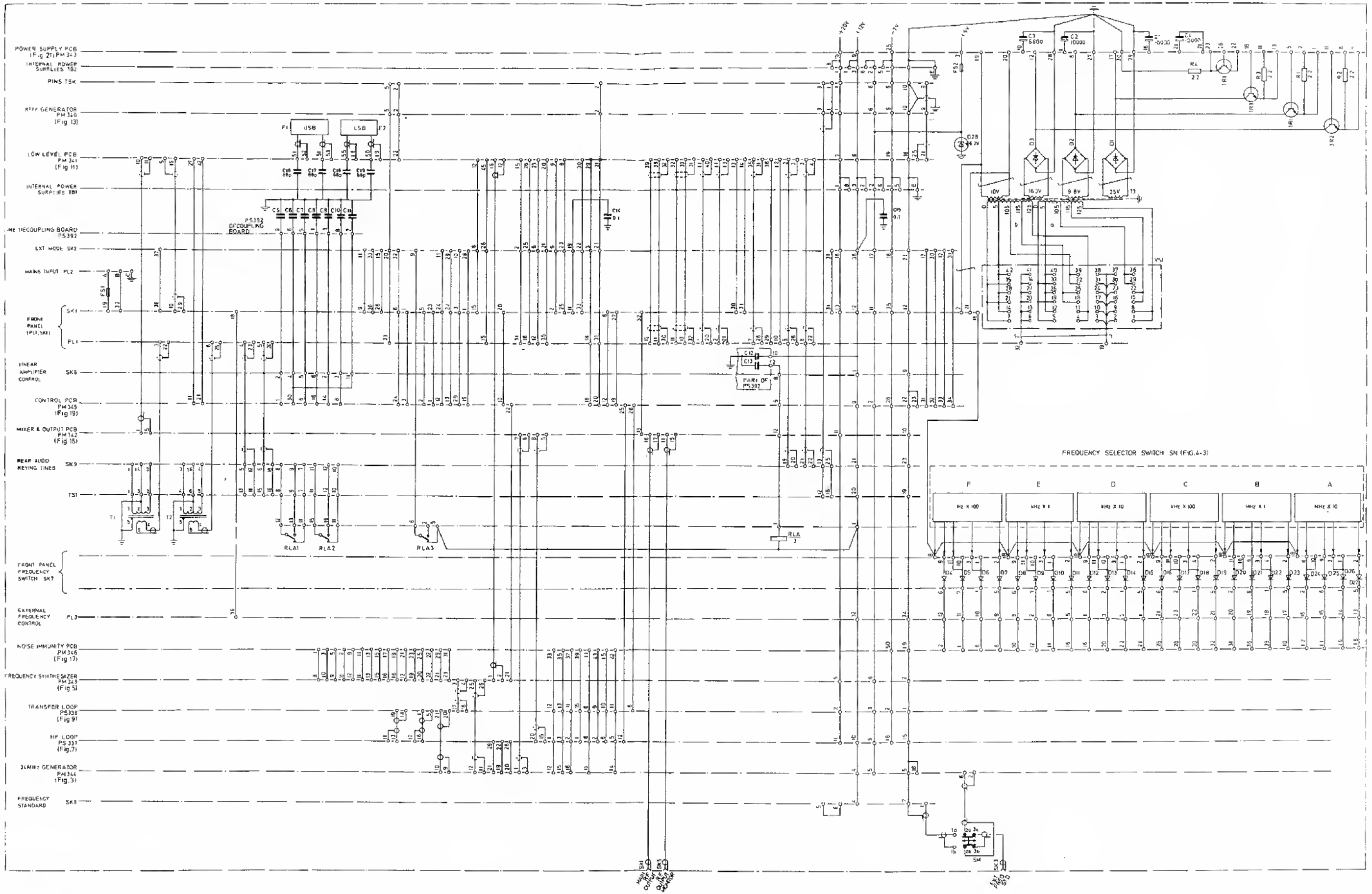
Component Layout : Chassis Top Fig. 25



W ON 2085	EC603206
3	4

Overall Interconnection Diagram: MA.1720

Fig. 28



WDN 2085	E C603200	
P	S	L

Overall Interconnection Diagram: MA.1720

Fig. 28